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The New York & New Jersey Bridge Co. has until June 7, 1895, in which to submit plans for the new structure designed on the requirements of the board of Engineer Experts. The recommendations of this board were approved by the Secretary of War on Dec. 12, 1894. The bridge company assumed that it had one year from that date in which to submit plans for the single-span structure extending from pier-head to pier-head, as it had already submitted plans for a cantilever bridge to the board of Experts, which plans were rejected. The Secretary of War and the Judge Advocate General now decide that this submission of plans to the board was not a compliance with the law requiring them to be submitted to the Secretary of War, and the Act of Congress of June 7, 1894, requires that plans of the bridge and its location must be submitted to the Secretary within one year of the publication of the Act.

Work is progressing steadily on the Brooklyn Bridge terminals, and it is expected that the new system of operation will be ready for use by September. The new Brooklyn station and roadways will have cost, when done, $270,000; the reconstructed New York station, $270,000; the car storage yard, real estate and structures, $868,356; New York roadways, $107,001; cable-driving plant, $198,455; railway and equipment, $327,500, making a total of $2,041,913.

An exhibition of patents is being held at the Grand Central Palace, New York city, and though of a somewhat limited and miscellaneous character, includes some inventions of technical interest, among which may be noted the Trueb temperature regulator, used on some Wagner cars; the Peckham street car truck; Sheffield hand cars and velocipede, models of the Wagner car framing system, and Leonard hydrostatic buffer, and a Studebaker street sprinkling cart. Models of car fenders are numerous.

The New York Rapid Transit Commission at its meetings on March 22 and 26 adopted resolutions changing slightly the routes and plan of construction from those described in our issues of Feb. 21 and March 6. The amended plan of construction provides that the two inner tracks of the four-track line may be depressed not more than 10 ft. below the level of the outer tracks, wherever such depression is deemed advisable. This may be taken to mean that the outer local tracks along Broadway will be brought up close to the street surface, and the inner express tracks will be depressed somewhat on account of the cable road conduit overhead. At express stations this depression will be increased so as to place the express platforms beneath the local tracks. It was also resolved that the road from Morris St. to 34th St. shall be built by tunneling beneath the street surface; but how a tunnel is to be driven with its roof within a foot or two of the surface of a crowded street is a problem that is not explained. All other parts of the line which are to be underground may be built by excavating from the surface, not more than half the width of the street being disturbed at one time.

Electricity is to be adopted for running local passenger trains on the New York Central R. R. between Buffalo and Niagara Falls, according to report. The Vanderbilt interests in the Niagara Power Co. are said to have dictated this move; but it is also stated that the change is to be made to meet the competition of the electric railway which is being built from Buffalo to the Falls. The Pennsylvania Co. is reported to be about to adopt electricity for its local passenger trains between Louisville, Ky., and New Albany, Ind.

The Wightman closed conduit system of electric railway, invented by Merle J. Wightman, of Scranton, Pa., is to be tried at Johnstown, Pa., for a length of 1,000 ft., and the rails, etc., have been made by the Johnson Co. An intermediate rail, in sections 3 ft. long, is laid in the middle of the track, and about 1 in. below the bottom of the rail is a steel ribbon conductor, which carries the current. Under the car is a powerful magnet, which runs on the middle rail, magnetizing it, so that the ribbon is drawn up to make contact with it, and delivering the current to the rail, whence it is taken off to the motors. Only two sections, or 6 ft. of track, are charged at one time, the ribbon dropping away from the rail as soon as the magnet has passed.

Mail cars are to be run experimentally on the Third Ave. and Broadway cable roads, in New York, the necessary arrangements having been made between the post-office authorities and the railway companies. It is intended to have mail sorting cars, with two to six sorting and distributing clerks on each car. The mail wagons will meet the cars at specified points and exchange bags. At present most of the local mail for the uptown sub-post-offices is carried on the elevated railways, mail being sent every half-hour.

Prices of street railway material have declined considerably during the past three years, as is shown by the following figures, taken from a daily paper:

	1892.	1895.
Girder rails, per ton.....	$40	$24
Car wheels, each.....	$8.25 to $8.50	$6 to $6.75
Insulated wire, per lb.....	20 cts.	14 cts.
Electric equipment, per car..	$1,400	$800 to $850
Cars	$4,200	$2,600

The General Electric Co. and the Westinghouse Electric & Mfg. Co. are said to be conducting negotiations by which further litigation between them over patents for lamps, motors, etc., will be suspended. An amalgamation of the two companies is also rumored.

Railway accidents during the past week have been few and unimportant, the most serious being the derailment of a passenger train on the South Atlantic & Ohio R. R., near Natural Tunnel, Va., March 17. The engine, mail car and express car went down the bank, but nobody was seriously injured.

A trestle on the Flint & Pere Marquette R. R., near Sears, Mich., gave way March 16, under the derailed car of a freight train, and 11 cars went down in the wreck. Nobody was injured.

A boiler at Kingsville, N. B., exploded March 20, killing one man and injuring eight others. The boiler was one of a battery of six shell boilers, carrying about 55 to 60 lbs. pressure. The boiler was found to be heavily encrusted with sediment.—A 60-HP. Allen boiler at the south mill of the Slater Woollen Co., Webster, Mass., exploded March 17, and three persons were injured. It was one of a battery of twelve boilers.

A new brick chimney, 65 ft. high and 14 ft. wide at the base, at the works of the Brooklyn Varnish Mfg. Co., Brooklyn, N. Y., fell March 21. The chimney was completed, with the exception of the coping, and the contractor claims that the accident was caused by the settling of the made ground, on which rested the barrels forming the footing for the scaffold poles. The scaffolding was braced by timbers let into the brickwork, and built on one side only, owing to objections on the part of the owner of the adjoining property, and in settling it therefore threw an uneven strain on the structure.

A gas explosion occurred March 20 in one of the mines of the Rocky Mountain Coal & Iron Co., near Evanston, Wyo., and nearly 60 miners were killed.

The Delaware, Lackawanna & Western R. R. and the Buffalo Grade Crossing Commission have signed an agreement by which the former agrees to do its share of the work in abolishing the grade crossings on its road at Elk St., Seneca St. and Abbott Road.

The mayor of Brooklyn has vetoed the ordinance to regulate the speed of the electric cars, on the ground that 10 miles per hour, as permitted outside the limit of one mile from the city hall, is too high, and that it permitted three persons to ride on the front platform. The mayor believes that the speed should be limited to 8 miles per hour within the crowded part of the city, with limits set by certain cross streets, and not by an indefinite radius. He also considers that only the motorman, the conductor or a policeman should be allowed on the front platform.

A bill is before the New Jersey Legislature providing that cities of that state above a certain population may require the elevation of railway tracks in their territory and the abolition of grade crossings. The expenses of this work would be apportioned as follows: 65% to be paid by the railway corporation, 15% by the city, and the remaining 20% by the state. In the case of insolvent railway companies, the Chancellor is directed to investigate the conditions and to decide whether they shall or shall not elevate the tracks. The bill has been engrossed and ordered to a third reading.

The deep-water question for Aransas Pass, Texas, is again being agitated, but with little prospect of an immediate resumption of work on the jetties. The citizens of Austin, 150 miles away, are deeply interested, and are attempting to raise funds by subscriptions in land; but so much time will be expended in examining titles, etc., and the time is so short before the date set by the Act of Congress of Jan. 9, 1894, for the completion of the work, that it is extremely doubtful if capitalists will take hold of it. The Redfish Bay Channel, Wharf and Dock Co. has contracted to dig a deep channel across the mud flat in front of the town to deep water in Aransas Bay; but little permanent gain is expected from this.

A railway car-ferry service, 260 miles long, is to be established between Peshtigo, Wis., and South Chicago. The specifications for the first two boats require each to carry 28 loaded cars. The boats will be very strongly built, with especial reference to passage through ice floes, and are expected to make a round trip every three days in the year. At the South Chicago landing the ferry boats will connect directly with the outer belt railway, connecting in turn with every Eastern railway. The move is regarded as important as demonstrating that the Ann Arbor ferry line is a success, from a business standpoint, and that goods can be transported cheaper in this way than by land connections. Mr. John N. Faithorn, long prominently connected with the Western Freight Association, as chairman, and a leading freight expert, is interested in the new line. Mr. S. M. Fisher, President of the new Wisconsin & Michigan R. R. Co., is also interested in the enterprise, as his system starts at Peshtigo Harbor, on Green Bay, Lake Michigan. Mr. Faithorn is Secretary and Treasurer of the railway mentioned.

The Pennsylvania Canal, according to the recommendation of President Roberts in the last annual report of the Pennsylvania R. R. Co., the owner of this canal, is to be abandoned. This canal extends from Nanticoke, Pa., to Columbia, Pa., and with its branches is 249 miles long. At Columbia it connected with the Susquehanna & Tidewater Canal, terminating at the head of Chesapeake Bay. The latter canal was leased by the Philadelphia & Reading R. R. Co. about 20 years ago; but this lease has lately been given up, and the canal itself is so injured by freshets that it is practically useless, and the Pennsylvania Canal finds itself without an outlet to tidewater. Later rumor says that the Pennsylvania Canal Co. has made a proposition to the state of Maryland, the owner of a large part of the Susquehanna & Tidewater Canal, to repair and operate this latter canal as a carrier of coal on a toll basis. The cost of such repairs would be later deducted from the tolls. Though this proposition does not agree with the recommendation of President Roberts in the report quoted, it seems reasonable and possible.

The Waukesha Hygeia Mineral Water Co., of Chicago, has been placed in the hands of a receiver. This company was organized in 1891 and secured a concession for the exclusive sale of water at the Chicago Exposition. To do this, a 100-mile pipe line was laid to Waukesha, at a cost of about $500,000, and bottling works, a pumping station, and costly pavilions were put up at the Glenn Springs. The original capital was $1,100,000 in 30-year bonds bearing interest at 6%. The pipe line was little used after the Fair, and the sale of water has been too limited to pay expenses. As a consequence, the company finds itself with the above bonded indebtedness and further obligations of $40,000. Mr. Charles C. Prest is the receiver, and Samuel M. Jarvis, of New York, and John F. Downing, of Kansas City, are the trustees. The enterprise was described in our issues of March 19, 1892, and Jan. 12, 1893.

Ballast of burnt black-wax soil is being tried on the Texas Midland R. R., the soil being burnt in the same way as clay for the same purpose, as described in our issue of Nov. 16, 1893.

SOME COMPARATIVE TESTS OF BUILDING STONES.*

By Coles A. Raymond, Wauseon, O., and Edward W. Cunningham, Urbana, O.; Graduates of the Class of 1894, Ohio State University.

This thesis, originally intended to cover all the ordinary tests recommended in the text-books, has limited itself to but a few which either directly or indirectly concern the durability of the material. The work as carried out included tests of weathering, absorption and specific gravity upon 16 different kinds of sedimentary rocks, both limestone and sandstone, a list of which is given below. We have been much hampered by a lack of proper appliances, and in consequence have followed our own methods where those previously recommended have not been permitted by circumstances. The stones tested were the following:

Weathering Tests.—The weathering tests were made with the following objects: 1, of comparing the several abilities of the several stones to resist the winters of the Northern states; 2, of discovering the manner of disintegration; and 3, of discovering the rate of disintegration. For this purpose four sets of 1-in. cubes were employed, of which the first was to bear 5 alternate freezings and thawings; the second, 10; the third, 15; and the fourth, 25.

Specimens of Ohio Stones Used in the Experiments.

Letter.	Local name.	Description.	County.	Geological position.*
A	Amherst buff	Sandstone	Lorain	Sub-carboniferous, Berea grit
B	Killbuck brown	" "	Holmes	Carboniferous, lower coal measures
C	Ohio blue	" "	Lorain	Sub-carboniferous, Berea grit
D	Frazersburg	" "	Muskingum	Carboniferous, lower coal measures
E	Ohio River blue	Freestone	Scioto	Sub-carboniferous, Cuyahoga shale
F	Buckeye brown	Sandstone	Knox	Carboniferous, lower coal measures
G	Cedar Run	" "	Muskingum	" " " " "
I	Coes	Freestone	Scioto	Sub-carboniferous, Cuyahoga shale
J	Buena Vista	" "	"	" " " " "
K	Fulton	Sandstone	Morrow	" " " Berea grit
L	Lithopolis	Freestone	Fairfield	" " " Cuyahoga shale
M	Sugar Grove	Sandstone	" "	Devonian, conglerons
W	Columbus	Limestone	Franklin	" " Niagara limestone
X	Dayton	" "	Montgomery	Upper Silurian, Niagara shale
Y	Springfield	Dolomite	Clarke	Devonian, conglerons
Z	Sandusky	Limestone	Erie	Logan conglom. " " "

* As given in reports of the Ohio Geological Survey—Dr. Orton's classification.

Absorption Tests.—The objects of these tests were also threefold, as follows: 4, to obtain the rate of absorption; 5, to obtain the time of absorption; and 6, to discover how close a relation exists between the weathering qualities of a stone and its absorption.

Description of Specimens.—The specimens in all cases were good of their kind. In ten cases, namely, A, B, D, E, F, G, I, J, K, L, slabs were sawed at a stone mill approximately 2×2 ins., and of indefinite length. Three specimens, C, W and X, were obtained in slabs 2 ins. thick, and of indefinite length and breadth. Rough 3-in. cubes of Z were procured at the quarry, while M and Y were received in large blocks. It is but fair to state that A, B and Z were furnished by the producers, the others, though well selected, being obtained by other means. The chemical tests referred to in the following description were simply rough approximations, being qualitative rather than quantitative. The work was done with the assistance and under the direction of the assistant in the Department of Metallurgical Chemistry. The specimens used may be described in three main divisions: sandstones, freestones and limestones:

1.—Sandstones, including A, B, C, D, F, G, K and M, and these may again be arbitrarily divided into fine sandstones (A, D, C and K) and coarse sandstones (B, F, G and M).

(a) Fine Sandstones.—Specimens A, C and K, belonging to one geological horizon, are of a very similar character, both in size of sand grains and in cement, which is mainly silicious. All contain small percentages of the carbonates of iron and lime, of which the former imparts to C and K their characteristic blue color, while A has been altered by oxidation to a light cream color. Specimen D is not as even in texture as the above-mentioned, but is close-grained and compact, showing under the microscope, when reduced to a thin section, quartz, felspar and muscovite. It is of a light brown color, imparted by the oxide of iron, presumably the hydrated oxide. A rough approximation gives about 4% iron oxide with a trace of carbonate of iron. All the above are easily worked by the stone cutter.

(b) Coarse Sandstones.—Specimen B is a rather coarse but handsome dark red-brown sandstone, pretty firmly cemented with about 2.5% of anhydrous ferric oxide. It contains also a trace of lime. In appearance F is similar to the preceding, but somewhat lighter in color. Its geological position is the same as that of B. The cement consists of about 1.4% iron oxide, probably partially hydrated, being too limited for permanency of finish. Specimen G is easily worked (in fact, too easily for permanency), is quite coarse, cemented with about 2.2% of iron oxide, gives a strong reaction in the test for lime and contains a very distinct trace of carbonate of iron. The color is light brown, approaching buff. Specimen M contains about 0.7% of oxide of iron, probably hydrated, the stone being yellowish in color. In small pieces it is easily crumbled in the fingers, and great difficulty was found in cutting the cubes properly. In spite of these facts, the stone shows a strength of over 4,500 lbs. per sq. in.

2. Freestones, E, I, J and L.—All of these are from the same geological horizon, occupying the place of a shale. E, I and J are found within a radius of 15 miles, while L is quarried nearly 70 miles from the nearest of the others. All are cemented with clay, are very fine-grained and homogeneous, with scarcely any visible indication of bedding planes. E is blue in color, and gives a very strong reaction for carbonate of iron. It is subject to disfiguration by a white efflorescence. I is faintly colored with ferric oxide. This and the following give a pretty strong test for iron carbonate. J is colored a dark drab by organic matter, probably petroleum, and contains a little ferric oxide. L is remarkably similar to E in all its characteristics, except that as far as we know it is free from efflorescence. In percentage of iron the stones rank as follows: 1, E and L; 2, I (a close second); 3, J.

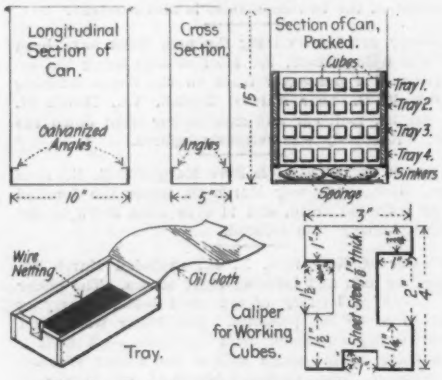


Fig. 1. Freezing Appartus and Caliper.

3. Limestones, W, X, Y and Z.—Of these specimens W is a fairly pure limestone, with about 93% carbonate of lime, and is highly fossiliferous, containing large numbers of shells, corals, etc. X is a pure semi-crystalline limestone of a nearly white color, containing considerable pyrite, and is very compact, giving a clear metallic ring when struck with a hammer. Y is a compact dolomite, containing about 53.5% of carbonate of lime and 45% magnesium carbonate, is of a yellowish color, somewhat streaked with red oxide of iron, and contains a great many very small cavities. Z is from the same geological horizon as W, is slightly fossiliferous, and has the characteristic odor of petroleum. It contains some sand grains and other impurities, and is of a rather handsome gray color.

Preparation of Specimens.—All breakages of sawed specimens to reduce them to approximate size were made by scribing or grooving on three sides in the plane of intended fracture to a depth varying from 1-32 to ¼ in., the fracture then being brought about by light blows on the unscribed side with the wedge pene of a hammer. Scribing was done by hand on all sandstones, and grooving with light chisel on the limestones. When the specimens were roughed out, as in the case of M, Y and Z, the work was done with mallet, chisel, pitching-tool and point, the specimen being bedded in sand. All stones broken out by either method were dressed to within about ⅛ in. of the final dimensions on a rapidly revolving emery wheel, to which a constant stream of water was applied. The surface thus approximately reduced was finished by hand on a cast iron plate, first with coarse sand and water and finally with sand which passed a No. 50 sieve, also with water. To obtain as nearly as possible exact dimensions, a special caliper of sheet steel, Fig. 1, was employed, and angles were checked by a try-square.

Weathering Tests.

As above stated, four sets of 1-in. cubes were employed. These, after being brought to the desired form and size, were engraved on a bedding plane with the letters A, B, C, etc., according to the system used, and on the opposite side with Roman numerals specifying to which of the four sets each belonged. All marks were cut in with light graver, propelled by hand, and sharp edges of letters rounded off. The specimens were then carefully washed with a stiff tooth brush to remove any clinging particles of sand and dirt, and put to dry in a hot air bath which maintained a temperature of 80 to 90° C. Weighings accurate to half a milligram, or to about 1-600 of 1% of the average weight of specimens, were taken at intervals until the results became constant. Then, after immersion for 36 hours in distilled water, the stones were ready for the test.

Apparatus.—The can in which the freezing tests were made was of galvanized iron, made watertight. On the inside, about 1½ ins. from the bottom, were soldered galvanized angles, of which the horizontal legs furnished a continuous shelf running entirely around the can. Four trays, each 2 ins. deep, with sides of thin pine stuff thickly coated with asphaltum varnish and with bottoms of galvanized wire netting, were fitted to slide into the can. The arrangement is shown in Fig. 1. The cubes, one set in each tray, were packed in cotton batting thoroughly soaked in distilled water and allowed to drain for a short time. Care was taken that no two specimens should be in contact. Over the tops of the boxes, which were slightly rounded up with batting, an oilcloth cover was snugly tacked. The trays were then inserted into the can, sponges being first placed below the shelf angle to absorb any water drip. It was found, however, that after the longest test the batting was still well soaked with water. The packed can was suspended in a brine tank at a temperature ranging between —11 and —7° C., and after remaining there two days was taken out and thawed in a room the temperature of which varied from 21 to 37° C., the process of freezing and thawing being alternated as many times as desired. During the experiment the time in the brine tank seldom varied more than a few hours from two days, the minimum time being 40 hours, the maximum 96 hours, and the average for the whole test 53 hours. The time out varied from 24 to 96 hours, averaging 42 hours. At one time a box examined after but 18 hours' exposure to a temperature of about 24° C. was found to be thoroughly thawed, and even warm to the touch. The four sets were treated as follows:

Set I. was frozen and thawed alternately five times; stone G showed a loss of cement on the surface and a corner was loosened; stone M disintegrating rapidly but lost evenly over the surface.

Set II., frozen and thawed alternately 10 times, was irreparably injured in a new air bath by the loss of combined water; stone G, however, was again observed to have lost a corner. Set I., which had been continued as a check, was also ruined in the same way as Set II.

*Awarded One-half the Sum of the Second and Third Prizes in Engineering News' Thesis Competition of 1894.

Set III., undergoing 15 repetitions of freezing and thawing, was successfully carried through; stone I was split along a bedding plane.

Set IV. was frozen and thawed 24 times, finishing the test, with a loss of five specimens by bad disintegration.

All specimens when finally removed from the brine tank were first thawed in the trays, then taken out, carefully washed by means of a fine jet from a wash bottle, dried, and weighed, as when first prepared. The losses by freezing will be found in the tables expressed in decimals of 1% of the entire weight of the specimens. The manner of disintegration is well shown in Figs. 2, 3 and 4, which are from negatives made immediately after Set IV. was taken out.

Fig. 2 shows the manner in which the freestones disintegrate, L and E having undergone 24, and I having undergone 19 alternate freezings and thawings. All three are very fine-grained freestones, apparently of great homogeneity, and when fresh do not display marked bedding lines, especially in the case of the two former. This illustration is the more important, inasmuch as it is a common practice in using the material to set it with bedding planes vertical and parallel to the face of the wall.

TABLE I.—Loss of Weight and Strength Due to Weathering Test:

Specimens.	Loss of weight in decimals of 1%. Frozen 5 times.	Frozen 15 times.	Frozen 24 times.	Crushing strength.[1] Before test.	After test.	Per cent of loss.
A	0.000	0.000	0.056	8,752	9,406	—7.5
B	0.000	0.064	0.080	5,535	3,737	32.5
C	0.014	0.0083	0.000	5,630	4,826	14.3
D	0.000	0.017	0.143	5,744	4,854	15.5
E	0.036	0.008	....*	.....	.....	....
F	0.028	0.381	....*	4,082	.....	....
G	0.234	0.305	....*	3,230	.....	....
I	0.000	....*	0.020	13,296	....[2]	....
J	0.000	0.051	0.017	12,372	12,185	1.5
K	0.000	0.0085	0.006	8,829	8,668	1.8
L	0.034	0.0055	....*	13,543	.....	....
M	0.224	3.154	....*	4,582	1,770[3]	61.4
W	0.008	0.048	0.093	.....	20,041	....
X	0.000	0.000	0.000	.....	21,488	....
Y	0.000	0.000	0.000	.....	13,813	....
Z	0.011	0.027	0.071	.....	12,281	....

* Discarded because of rapid disintegration. See Figs. 2, 3 and 4.

[1] The first column is reduced from tests of 2-in. cubes, and the second column from 1-in. cubes, of Set IV. All reduced under the assumption that crushing strength of cubes is proportional to bed area. See Baker's "Masonry Construction," p. 9; Eng. News, June 23, 1888; pp. 511, 512.

[2] Face plates broke at 12,650 lbs.

[3] Frozen and thawed only 19 times.

TABLE III.—Relative Rankings of Stones for Weathering and Absorption.

Rank.	Specimen.	Weathering.—Average loss, 3 sets.	Absorption—after 1 hr.[1]—Specimen.	P.c. of wt.	P.c. of vol.	Ultimate absorption.[1]—Specimen.	P.c. of wt.	P.c. of vol.
			Limestones.					
1	X	0.000	X	0.00	0.00	X	0.00	0.00
	Y	0.000						
2	.....	.....	W	0.39	1.00	W	1.06	2.74
3	Z	0.036	Z	0.49	1.23	Z	1.84	4.61
4	W	0.050	Y[2]	2.40	5.84	Y[2]	3.05	7.43
			Freestones.					
1	J	0.023	J	1.62	3.56	E	4.02	9.56
2	E	....*	I[3]	2.67	5.95	J	5.14	11.39
	I	....*						
3	.....	....*	F	2.66	6.33	I	5.18	11.54
4	L	....*	L	4.64	10.39	L	5.59	12.53
			Ferruginous Sandstones.					
			—Absorp., 5 mins.[1]—					
1	B	0.48	D	2.47	5.35	D	6.37	13.79
2	D	0.54	G	3.54	7.54	B	7.31	14.93
3	F	....*	B	4.28	8.74	G	7.04	15.00
4	G	....*	M	7.14	14.95	M	7.39	15.89
5	M	....*	F	8.10	16.47	F	10.45	21.24

* Rankings based on judgment previous to and entirely independent of the absorption ranking. See Figs. 2, 3 and 4.

[1] All rankings for absorption are based on per cent. of volume of the stone, since it is the relation of the volume of water to the volume of stone which influences weathering, rather than the ratio of their respective weights. In consequence, ranking does not always agree with per cent. of weight.

[2] Y takes lower rank than it deserves, because of the many small cavities which it contains.

[3] The close correspondence in amount absorbed in one hour by E and I is to be noted.

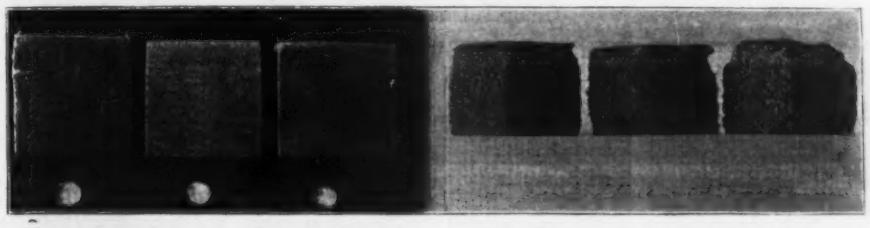


Fig. 2. View Showing Disintegration of Freestone.

Fig. 3. View Showing Disintegration of Sandstone.

Fig. 3 shows loosely cemented sandstones, all of which passed through 24 freezings; M and F appear as when taken from the tray, while G has been freed of loose particles; M has lost about the same amount as G.

Fig. IV. shows Set IV. as it appeared when first opened after the test. An apparent discrepancy is noted in the cubes occupying the upper corners of the tray, as one is numbered III. These cubes, however, belong to a separate test not herein noted. The condition of stone L was not apparent until removed from the box.

Absorption Tests.

In these tests 2-in. cubes without flaws were employed. After drying thoroughly in a hot-air bath the stones were immersed in distilled water, which throughout the experiment maintained a temperature between 18 and 21° C., the cubes being covered to a depth of about ¼ in. To obtain each point on the curve, the specimen was taken quickly from the water, dried on the surface with bibulous paper and weighed accurately to ½ grain or about 1-8900 of its dry weight, one such operation occupying about a minute, which was allowed for in group (c). The stones were divided into three groups, according to their judged rapidity of absorption, as follows:

Group (a). Limestones and freestones, including E, I, J, L, W, X, Y and Z.

Group (b). Fine sandstones, including A, C and K.

Group (c). Coarse sandstones, including B, D, F, G and M.

The tables of increase in weight and final absorption for each group are given below, all increase of weight due to absorption being expressed in percentage of the weight of cubes dry. In the case of stone A a point will be found on its curve which is not located in the table. This was found by another specimen taken from the same block and afterwards used to check. The results were closely concordant, as shown in Tables II. and III.

Stones A, C and K were omitted from these tables because the absorption was nearly completed when the first weighings were taken, the first part of the curves being approximately located by a specimen of A.

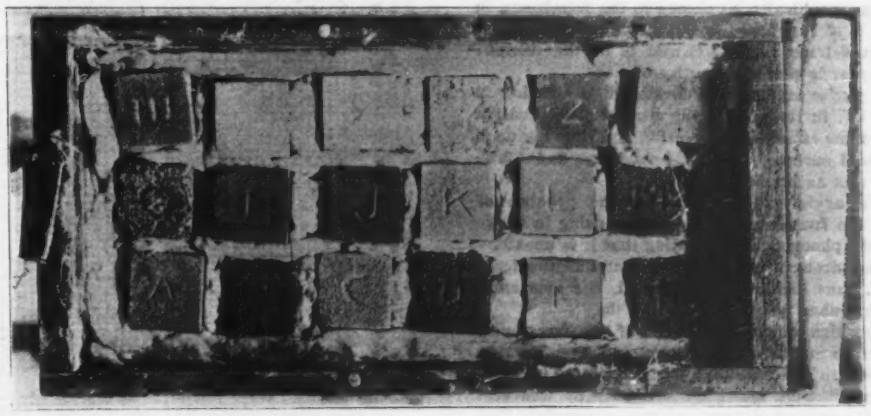


FIG. 4. VIEW OF FOURTH SET OF SPECIMENS AFTER THE WEATHERING TEST, FREEZING AND THAWING 24 TIMES.

TABLE II.—Rate of Absorption. Group (a), Limestones and Freestones.

Specimen.	Dry weight, grains.	Per cent. of increase over dry weight after immersion for 1 hr.	3 hrs.	6 hrs.	12 hrs.	24 hrs.	48 hrs.	96 hrs.		Per cent. of vol. occupied by water.
W	5,174	0.39	0.52	0.70	0.83	0.93	1.04	1.06	....	2.74
X	5,520	0.00	0.00	0.00	0.00	0.00	0.00	0.00	....	0.00
Y	4,995.5	2.40	2.69	2.71	2.78	2.89	2.89	3.05	....	7.43
Z	4,973.5	0.49	0.66	0.84	1.05	1.32	1.56	1.84	....	4.61
E	4,622	2.66	3.50	3.68	3.79	3.81	3.94	4.02	..	9.56
I	4,535	2.67	3.75	4.43	4.72	4.85	5.01	5.18	....	11.54
J	4,513	1.62	2.55	3.32	4.06	4.61	4.94	5.14	....	11.39
L	4,328	4.64	5.04	5.24	5.31	5.34	5.48	5.59	....	12.53
		Group (b). Fine Sandstones.								
		30 mins.	90 mins.	3 hrs.	6 hrs.	12 hrs.	24 hrs.	48 hrs.	96 hrs.	
A	4,219	5.10	....	5.10	5.12	5.29	5.48	5.59	6.26	13.22
C	3,963	6.46	....	....	6.46	6.50	6.74	7.01	7.42	15.67
K	4,286	4.76	4.88	5.02	....	....	5.11	5.44	5.93	12.58
		Group (c). Coarse Sandstones.								
		5 mins.	10 mins.	15 mins.	30 mins.	1 hr.	2 hrs.	24 hrs.	48 hrs.	
B	4,020	4.28	5.67	6.34	6.54	6.69	6.69	7.01	7.31	14.93
D	4,130	2.47	3.56	4.21	5.25	5.67	5.79	6.08	6.37	13.79
F	3,838	8.10	9.12	9.25	9.54	9.60	9.60	10.19	10.45	21.24
G	4,179	3.54	5.86	6.41	6.58	6.58	....	6.92	7.04	15.00
M	4,203	7.14	7.35	7.37	....	....	....	7.59	7.59	15.89

Conclusions.

We feel that our data are too limited to give the deductions therefrom anything like complete stability, but hope that the work will be of sufficient interest to induce others to make investigations along the same lines. We will, however, record here briefly points which have been suggested by our results.

The first four objects stated in our introduction are quickly disposed of by referring to the text, simply noting that rate of disintegration increases with exposure.

5. The time of absorption for sandstones is surprisingly short. In most cases the gradual increase after the first half-hour is, we believe, due at least in part to the slowness in the escape of confined air, and we are convinced that by a gradual lowering into the water, as has been recommended (see Appendix II., Vol. XI., Trans. Am. Soc. M. E.), the ultimate absorption of 2-in. sandstone cubes may be reached practically in from 30 minutes to one hour.

6. When judiciously used, absorption tests on stones of similar character are of great value in determining relative weathering qualities. See Fig. 5, which is adapted from a prize thesis of 1892. Although in the diagrams for the ferruginous sandstones the law is not apparent at a glance, observe that the B and F lines slant downward to the right, while the D, G and M lines slant upward to the right. B and F are of a red-brown color, indicating a cement of anhydrous ferric oxide, while D, G and M are yellow, or yellowish-brown, in color, indicating a cement of the hydrated oxide. This clearly gives the preference to the anhydrous oxide, the weathering being less for a greater amount of absorption.

Further, we believe that the relative weathering

qualities of stones of similar character may be more accurately determined by a careful and judicious observation of rates of absorption than by ultimate absorption, in support of which see the diagrams of freestones in Fig. 5. These stones are so nearly

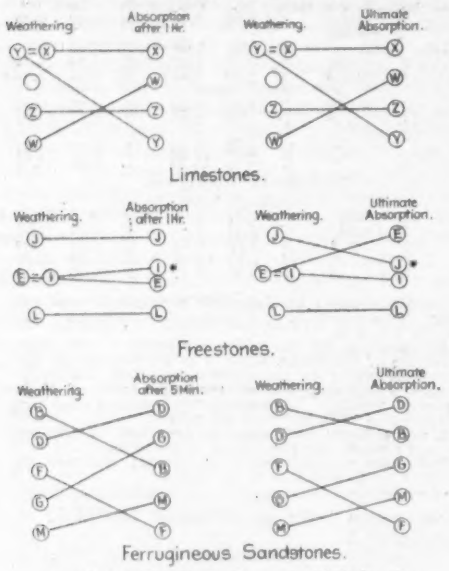

Weathering.
Absorption after 1 Hr.
Ultimate Absorption.
Limestones.
Freestones.
Ferruginous Sandstones.
* Notice in the Tables the close Correspondence in the Amounts absorbed by the Stones indicated by Tangent Circles.

Fig. 5. Graphical Illustration of Table No. 3.

alike that they may permit a generalization of this kind. The relation is also clearly shown in the absorption curves of Group 2, Fig. 6. We would be pleased to see the point developed.

Notes.—A few notes of minor importance may be appended.

1. The similarity in results derived from stones of the same geological horizon, though widely separated geographically, as shown in the freestones, in W and Z of the limestones, B and F of the ferruginous sandstones and A, C and K of the silicious sandstones, is perhaps worthy of note.

2. A pyrite crystal was developed in grinding X of Set IV. in the weathering test, and observation taken of the effect of the freezing and thawing upon its ground surface. After 24 freezings and thawings it was as bright as ever.

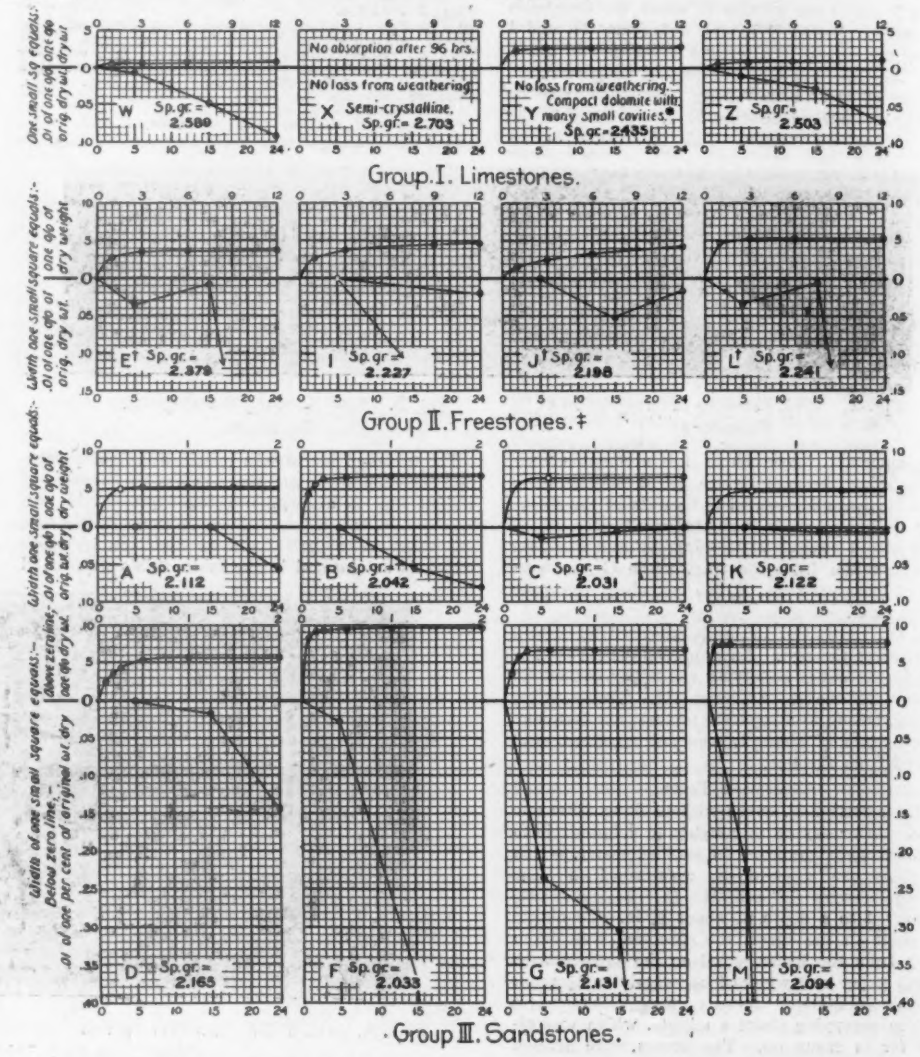
3. We again call attention to the practice of setting the freestones on edge when using in range work, the photographs indicating that it is unsafe.

4. The strength of M, which contains the least cement, runs higher than expected, the maximum for 2-in. cubes being over 19,000 lbs.

5. The high crushing strength of the freestones, both before and after weathering, indicates forcibly that strength and durability do not go hand in hand. W, also, although losing quite rapidly by weathering, still retained a high crushing strength. The latter when in a wall has often been found to have a rotten interior while displaying a fair front, but in some cases where exposed to city smoke and gases loses by scaling from the surface.

Specific Gravity.—The following tests for specific gravity may contain something of interest. Of the sandstones and freestones three specimens of each were used, two of which were originally adjacent, while the third was chosen at random. For each of the limestones two sets were selected at random. The specimens, which were of small size, varying between 20 and 40 grams in weight, were broken into convenient shape, and all sharp corners rounded off in a manner similar to that described by Gillmore, the finishing being done as with the cubes. The accuracy of the balances was such that a variation of .0001 gram was detectable. The Gillmore method and the paraffine method were both followed.

Gillmore's Method.—As is well known, in this method are used: first, the dry weight; second, the weight of the stone saturated with water, and third, the weight of the saturated stone in water, the formula being Sp. gr. $= \frac{W}{W' - W''}$, where W = dry weight, W' = wet weight, and W'' = weight in water of the saturated stone. The stones were first dried to constant weight in an air bath, the temperature of which varied between 80 and 90° C. For the wet weight the specimens were thoroughly saturated with distilled water; then, after removing the surplus water from the surface with bibulous paper, the weights were immediately taken. It is found that in this method there is a small but appreciable error due both to slight alterations in the time of applying the bibulous paper and to a continual evaporation from the surface of the specimen during the weighing. Supposing that this error amounts to 15 milligrams, the result will be affected by 2 in the third decimal place. Such an error may easily occur with any operator and probably accounts for the discrepancies between the two methods.


Group I. Limestones.
W Sp. gr. = 2.589
No absorption after 96 hrs.
No loss from weathering.
X Semi-crystalline. Sp. gr. = 2.703
No loss from weathering.
Y Compact dolomite with many small cavities.* Sp. gr. = 2.435
Z Sp. gr. = 2.503
E† Sp. gr. = 2.378
I Sp. gr. = 2.227
J† Sp. gr. = 2.198
L† Sp. gr. = 2.241
Group II. Freestones.‡
A Sp. gr. = 2.112
B Sp. gr. = 2.042
C Sp. gr. = 2.031
K Sp. gr. = 2.122
D Sp. gr. = 2.165
F Sp. gr. = 2.033
G Sp. gr. = 2.131
M Sp. gr. = 2.094
Group III. Sandstones.

Curves above zero line are of absorption. Curves below zero line are of weathering.
Horizontal scale above zero line indicates hours immersed; — below zero line, times frozen.
*Rapid rise in absorption curve is explained by character of stone:— its many small cavities quickly fill with water.
†Each point of weathering curve was determined by an independent specimen — which explains apparent incongruity of gain in weight after continued weathering
‡For convenience the horizontal scale of the absorption curves in Group 3 was made to differ from the preceding.

FIG. 6. DIAGRAMS OF ABSORPTION AND WEATHERING.

Paraffine Method.—As before, the stones are first dried to constant weight, after which, as soon as convenient, they are immersed in melted paraffine, kept at the proper degree of fluidity by suspending the containing vessel in steam. After remaining in the paraffine bath till bubbles cease to escape, the stone is taken out, carefully drained of surplus paraffine while hot, and allowed to cool. The immersion is now made a second time, to close chance openings, which, however, were not in any case indicated in our work. Treated thus, the stone should show no greasy surface whatever, having more the appearance of saturation by water, the paraffine being just even with the surface. As a consequence as nearly as possible the exact amount of water displaced by the stone is obtained, which, we believe, gives it a higher degree of accuracy than the wet method. The formula of Gillmore is easily amended to suit the paraffine method, making W = weight dry, W' = weight in air saturated with paraffine, and W'' = weight in water with paraffine. In the table which follows, the first column of results is obtained by Gillmore's method and the second column is a parallel test, using the same specimens in the paraffine method. It will be noted that the results by the wet method are in most cases higher than by the paraffine method, which perhaps indicates that the wet weight of Gillmore's formula is often too small, in consequence of overdrying. The results of column number two of the paraffine method are noticed to check quite closely with column number one of the same method, the two specimens having been originally adjacent, as previously noted.

TABLE IV.—Specific Gravity Tests. Cu. ft. Water = 62.5 lbs.

Specimen.	Gillmore's meth.*	Sp. gr. by paraf. meth. Adj. spec'ns. No. 1.	Sp. gr. by paraf. meth. Adj. spec'ns. No. 2.	Sp. gr. by paraf. meth. Random spec'ns.	Av. of paraf. results.	Wt., cu. ft., paraf. meth.
A	2.107	2.098	2.097	2.142	2.112	132
B	2.0495	2.034	2.044	2.058	2.042	128
C	2.034	2.027	2.030	2.037	2.031	127
D	2.169	2.163	2.163	2.170	2.165	135
E	2.380	2.386	2.392	2.362	2.379	149
F	2.035	2.031	2.036	1.954	2.033	127
G	2.117	2.120	2.132	2.142	2.131	133
I	2.225	2.225	2.229	2.228	2.227	139
J	2.210	2.197	2.201	2.197	2.198	137
K	2.126	2.122	2.132	2.112	2.122	133
L	2.243	2.237	2.244	2.243	2.241	140
M	2.080	2.076	2.084	2.123	2.094	131
N	.....	.....	2.067	2.068	.....	2.0675	129
			—Random specimens.—			
W	.....	.....	.....	2.616	2.562	2.589	162
X	.....	.....	2.704	2.702	.....	2.703	169
Y	.....	.....	2.461	2.409	.....	2.435	152
Z	.....	.....	2.492	2.514	.....	2.503	157

* Same specimens as first paraffine.

For favors received our thanks are due to Prof. Edward Orton, State Geologist of Ohio, for invaluable assistance; to Prof. C. Newton Brown, of the Department of Civil Engineering, Ohio State University; to the Fish Stone Co.; L. H. Goddard, of the firm of Mills & Goddard, and the L. Hoster Brewing Co., all of Columbus, O.; to Professors Robinson, Thomas, Lord and Bradford, of the Ohio State University, as well as their assistants. To all these, and to many others who have helped us in the furtherance of our work, we extend our warmest thanks.

THE CANADIAN SHIP CANAL LOCK AT SAULT STE. MARIE, ONT.

(With Inset.)

The formal opening of the new ship canal lock at Sault Ste. Marie, Ont., noted in our issue of Oct. 4, 1894, brings to a practical completion the second largest canal lock in the world, and gives the Canadian Government an unbroken waterway from the western shores of Lake Superior to the Straits of Belle Isle. We say the second largest lock, since the still greater lock, which the United States Government is building just across the river, is so near completion that,in a few months at most, the Canadian lock will be compelled to occupy second position, although its earlier completion entitles it at present to the first place in the list of the great ship canal locks of the world.

Development of the Canadian Canal System.—Before describing the lock work, however, it is of interest to trace briefly the development of the canal system of which it is at present the end, and which will give the Dominion of Canada within the next few years a waterway 14 ft. deep and 2,384 miles long from the Atlantic Ocean to the head of Lake Superior. Of this waterway about 72 miles will be artificial and the remainder the natural navigation of the St. Lawrence River and the Great Lakes. The artificial part only of this waterway will be mentioned here. This comprises the six short canals along the St. Lawrence River, between Montreal and Lake Ontario, known as the St. Lawrence Canals; the Welland Canal, connecting Lake Erie and Lake Ontario, and the Sault Ste. Marie Canal, connecting Lake Huron and Lake Superior, of which the new lock is a part.

The first practical step toward the construction of these artificial waterways was taken in 1815 and 1816, although they had been talked of long before, and, indeed, the rapids of the St. Mary's River and some of the rapids of the St. Lawrence had been passed by primitive canals and locks as early as 1798. In 1815 the legislature of Lower Canada voted a grant of money to build a Lachine Canal, and in 1818 a joint "Commission" from Upper and Lower Canada reported in favor of a canal system on the St. Lawrence River, the canals to have a minimum depth of water of 4 ft. Work was begun on the first Lachine Canal in 1821, and it was completed in 1825 at a cost of $440,000. The canal was 28 ft. wide at the bottom, 48 ft. wide at the top and 4½ ft. deep, and the locks were of masonry 100 ft. long and 20 ft. wide. Hardly had the Lachine Canal been finished when the Royal Engineer in charge of the Rideau Canal, then being built to connect the Ottawa River at Ottawa with the St. Lawrence at Kingston, urged the Government to construct the remaining St. Lawrence canals with longer and wider locks, and with a depth of water of 9 ft. This the Government decided to do in an act passed in 1832, and the system was finally completed with the enlargement of the Lachine Canal to the new dimensions in 1848. The dates of completion and dimensions of these St. Lawrence canals are shown by the accompanying table, which also gives similar data of the Welland and Sault Ste. Marie canals for purpose of comparison.

Meanwhile, during the construction of the St. Lawrence canals, the Welland Canal, between Lake Erie and Lake Ontario, had been completed and enlarged once. This canal was begun by a private stock company in 1824, after several years' investigations by Government commissions, and was completed in 1829. It was 27 miles long, with 40 locks, constructed of wood, 110 ft. long and 22 ft. wide, and with 8 ft. depth of water on the sills. After about ten years' service, during which time the work had reverted to the Government, the locks became practically worn out, and were enlarged to the dimensions first given in the table. This enlargement was completed about the time that the St. Lawrence system of canals was finished, and, as will be seen, gave an unbroken waterway 9 ft. deep from Montreal to Sault Ste. Marie and Lake Michigan ports.

After the union of the Canadian provinces, effected by the British North American Act, in 1867, further steps began to be taken toward developing the canal system. In 1870 a canal commission was appointed, which reported in 1871, advising a uniform and enlarged waterway, with locks 270 ft. long, 45 ft. wide and 12 ft. depth of water on the sills. This depth of water on the sills was increased to 14 ft. in the final act authorizing the work, which was shortly afterward passed by the Government. The enlargement of the Welland Canal to these dimensions was completed in 1887, and the work on the other canals is under contract to be completed in 1895. It should be noted, however, that instead of enlarging the Beauharnois Canal, another canal, several miles longer, but with fewer locks, is being constructed on the opposite side of the river. This is called the Soulanges Canal.

First Sault Ste. Marie Canal.—Returning now to the Sault Ste. Marie Canal; it was stated above that a canal had been built across St. Mary's Island as early as 1798. This canal was built by one of the Northwest fur companies, and, according to such records as can be obtained, was 300 ft. long and 45 ft. wide, with a lock that raised the water 9 ft., or one-half the total fall at the rapids, so that the remaining height must have been overcome against the current—no great task for the light bateaux of the fur hunters. The lock is said to have been of wood, 38 ft. long and 8¾ ft. wide, and built like a flume. The lower gates were raised by a windlass and the upper gates folded and were provided with valves for the admission of water to the lock chamber. The boats were conducted into the lock "through a plank flume 300 ft. long and 6 ft. high, and just the width of the canal." A round log cribbing, 12 ft. wide, is stated to have extended along the canal, forming a tow-path for the oxen that drew the boats upstream. This canal was completed in 1808, but in July, 1814, a body of 150 Americans, under the leadership of a Major Holmes, crossed the river and pillaged the adjoining post and burned the lock, flume, etc., to the vater's edge. Between the building of this primitive Sault Ste.Marie Canal and the construction of the great work of the same name, which is illustrated here, 96 years have elapsed.

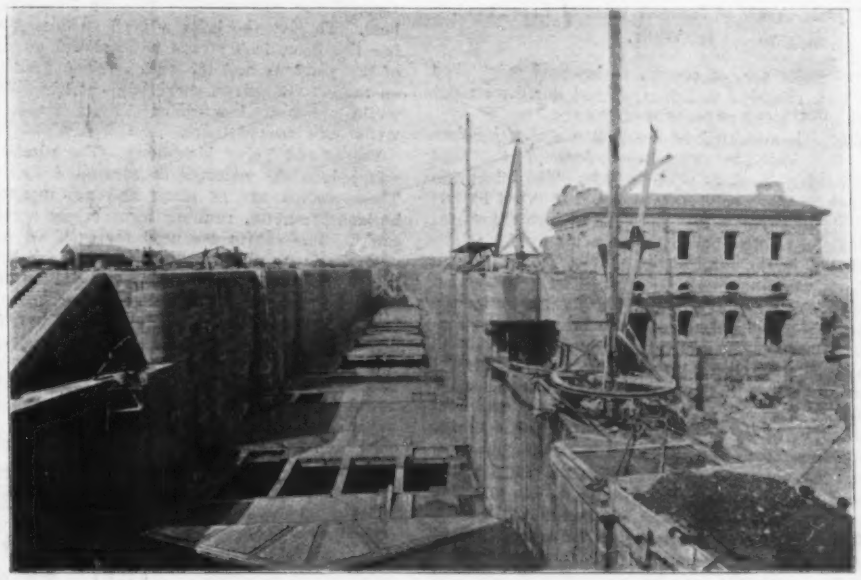


FIG. 1. VIEW OF LOCK CHAMBER AND POWER HOUSE FROM EAST END, CANADIAN SHIP CANAL LOCK, SAULT STE. MARIE, ONT.

	Length, miles.	No. of locks.	Locks. Length, ft.	Locks. Width, ft.	Rise, ft.	Depth on sills, ft.	Date of completion.	Dist. from preceding canal, miles.
Lachine	8½	5	200	45	44¾	9(a)	1848(b)	....
Beauharnois	11½	9	200	45	82½	9	1845	15
Cornwall	11½	7	200	55	48	9	1842	22¾
Farran's Point	¾	1	200	45	4	9	1847	5
Rapide du Plat	4	2	200	45	11½	9	1847	10½
Galops	7¾	3	200	45	15¾	9	1847	4½
Welland	27 1-5	27(c)	150	26½	330	10¼	1843(b)	....
Welland	26¾	25	270	45	326¾	14	1887(b)	....
Sault Ste. Marie	3,500 ft.	1	900	60	18	21	1894	....
Total	71.48	55	....	..	554	..	....	....

(a) Two of the five locks had a depth of 18 ft.
(b) Completion of enlargement.
(c) Two locks 200 ft. × 40 ft.; one 220 ft. × 45 ft., and remaining 24 as given.

New Sault Ste. Marie Canal.—The total length of the new canal across St. Mary's Island is 3,500 ft., and the dredged approaches under water at the two ends are about 18,000 ft. long, with a depth of water of 21 ft. The essential feature of the work is, of course, the lock by which the 18-ft. fall of the Sault Ste. Marie is overcome. This lock is built of masonry, and is 900 ft. long between quoin posts and 60 ft. wide, with a depth of water of 20¼ ft. on sills at low water. The height of the top of the walls above the floor of the lock chamber is 43¾ ft. Fig. 1 is a view of the lock chamber from the east end. The power house is shown in the foreground, and along the bottom of the lock are the leaves of the gates ready to be hung. Beyond the first half-dozen leaves is the barge, with its top framework for holding the gate leaves upright while they are being floated into position.

This extreme length of the lock chamber, as compared with its width, has caused considerable criticism,it being contended that the width of 60 ft., while far too wide for a single boat, is much too narrow for two boats side by side, so that a very considerable space is useless. In fact, when the plans were first prepared, it was intended to have a lock 100 ft. wide, and a part, at least, of the lock pit excavation was made on this assumption, but the width was afterward narrowed to 60 ft., it being considered that it was not advisable to use wooden gates of greater width. The Government engineers also objected to having the width of the chamber at the body greater than at the gates, as

is the case with the 500-ft. lock on the American side, so the width was made uniform throughout.

The gates are of wood, and do not differ materially in design and construction from the usual practice in lock-gate construction. There are five sets of gates—two at the upper or west end, and three at the lower end—i. e., a lock and guard gate at each end, and an extra lock gate at the lower end, for use in case the other lock gate fails. The

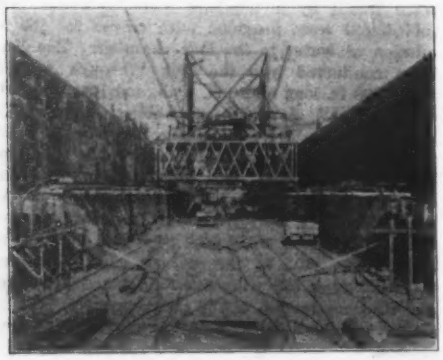


Fig. 2. View of Traveler Used to Erect Lock Walls.

guard gates are, of course, to be used only when the lock chamber is being pumped out for repairs to the lock gates or for other purposes.

Water is admitted to the lock chamber by four 8 × 8-ft. culverts, extending underneath the floor and having openings at their tops. The inlets and outlets to these culverts are closed by steel butterfly valves. Both the valves and gates are operated by electric power, the machinery for which is shown in the inset sheet.

Lock Chamber and Culverts.—The construction of the lock will have taken fully five years by the time it is completed. Work was begun by the contractors, Hugh Ryan & Co., Toronto, Ont., in 1889, the first move being to construct a water-power dam and flume in the narrow stream crossing the island. The head of water thus secured was used to run five 52-in. turbines, three of which operated air compressors, one the shafting for the machine shop and one a cable-power plant, by which the pumps, stone crushers and derricks on the lock pit work were run. Excavation was begun in May, 1889, and, as before noted, was for a lock 100 ft. wide at first. The material excavated was a red Potsdam sandstone rock, interspersed with layers of shale and occasionally of sand. The material was removed by derricks placed on the banks and by tram-cars running up inclines.

Upon the completion of the excavation the rock was leveled off by a layer of Portland cement concrete and the stone masonry work begun. There were 70,000 cu. yds. of this, the most of which was, of course, in the side walls. The facing was of Amherstburg limestone laid in 2-ft. courses, with 1 cement to 1 sand Portland cement mortar. The backing was of limestone, obtained from Manitoulin Island, laid with the same mortar as the facing. Travelers were used for laying the masonry, one of which is shown in Fig. 2. This traveler consists, as will be seen, of a Howe truss span stretching transversely across the excavation inside the walls, and running on tracks laid on the bermes between the sides of the culvert excavation and the side walls. On each corner of this Howe truss span was placed a derrick, or four derricks in all, for handling the stones, which were conveyed into the lock pit by tramways. The two forward derricks were used in laying the facing, and the two rear derricks for laying the backing, the whole traveler moving along the lock pit as the work proceeded. Work began on the masonry in September, 1892, and about 7,000 cu. yds. were laid that year. The remaining 63,000 cu. yds. were laid between about the first of May and the first of November, in 1893, or at the rate of about 10,000 cu. yds. per month. The surplus excavation, including that portion made according to the original plan for a lock 100 ft. wide, was filled with earth taken from the canal and puddled in with water.

The lock chamber is, as already stated, filled and emptied by means of culverts running longitudinally underneath the floor. There are four filling culverts, beginning just above the upper lock gate and ending with a transverse wooden bulkhead, which separates them from the inlet to the emptying culverts, also four in number, located just above the first set of lower lock gates. The outlet for the discharge culverts is just below the second set of lower lock gates. In the floor of the lock chamber there are 152 openings into the filling culverts through which the water enters the chamber.

The culverts are constructed entirely of wood. Those for filling the lock are 8 × 8-ft. inside, and those for emptying 8 × 10½ ft. inside. In constructing the culverts 12 × 15-in. longitudinal sills were first bolted to the rock foundation, with 1¼-in. round bolts 6 ft. long or over, spaced 6 ft. apart. On these 12 × 12-in. transverse timbers were laid 6 ins. apart, and the interstices filled with Portland cement concrete and grout flush with their tops. On the top of this was laid a flooring of two thicknesses of plank, 3 ins. and 2 ins. thick, respectively. The walls between the culverts, 2 ft. thick, composed of two thicknesses of 12 × 12-in. timbers, were then built and capped, with 12 × 12-in. transverse timbers, placed 6 ins. apart and covered with a double flooring of 3-in. and 2-in. plank. This flooring was then bolted to the longitudinal sills first laid by bolts extending down through the culvert walls and the transverse timbers. To give the bolts a good surface for holding the floor, iron straps were placed on the top of the planking and the nuts screwed firmly down on these. Of course, these bolts had to be put in while laying the longitudinal sills, and the culvert walls built around them.

Valves and Valve Machinery.—The admission of water into the culverts is controlled by valves. These valves are of steel, and are mounted on horizontal shafts, running transversely across the canal. The shafts are used for each set of four valves, one running from the right side-wall chamber to the center and carrying two valves, and the other from the left side-wall chamber, also carrying two valves. At the ends of each shaft in the wall chamber is a crank arm to which a vertical draw-rod, 55 ft. long, is attached. This draw-rod is placed in a well in the lock wall, and when moved vertically up or down by the operating mechanism, opens and closes the two valves on the shaft to which it is attached—i. e., the valves are operated in pairs.

Before referring to the illustrations of the valve and gate machinery on the inset sheet, a brief description of the electric power-generating machinery in the power house is necessary. Two 45-in., 150-HP. turbines supply the power for operating the generators. These turbines are set horizontally, and are supplied with water from the upper level by a 6-ft. 8-in. steel pipe, placed at the back of the lock wall. Just before entering the power house this supply pipe divides into two 5-ft. pipes, one for each turbine. The discharge pipes from the turbines are also 5 ft. in diameter. The turbines are placed on the first floor of the power house, and operate by belt a horizontal countershaft on the second floor. From this countershaft are operated the dynamos and generator on the second floor and the centrifugal pump shafts on the first floor. Ordinarily only one turbine will be used for running the generators, leaving the other free to operate the tools in the machine shop; but when it is required to pump out the lock the two wheels can be coupled and used to operate the centrifugal pumps. There are two of these pumps, and they have a combined capacity of 32,000 gallons per minute. It is expected that the two pumps will lay the lock chamber dry in six or seven hours. It should be noted also that valves in the supply pipe permit of either or both turbines being laid dry when necessary.

The electric machines in the power house consist of two dynamos for electric light, and a generator supplying power to the motors operating the gates and valves. This generator is of 45-K-W. capacity, and submarine cables connect it with the motors, which are of 25 HP., and of the ordinary street-car type. Fig. 3 shows the arrangement of the two motors for operating one gate leaf and one pair of valves. For the valve machine the split wheel is placed on the horizontal shaft A (Figs. 3 and 4), just as it would be placed on a car axle. From the shaft A the operation of the screw power machine for the valves may be traced through gears B, C and D to the draw-rod, which extends vertically down the well and connects with the crank arm of the shaft carrying the valves, as described above. It will be seen that the upper end of this draw-rod connects with the crosshead of the screw power machine, and is pulled up and down as the screw is operated by the motor.

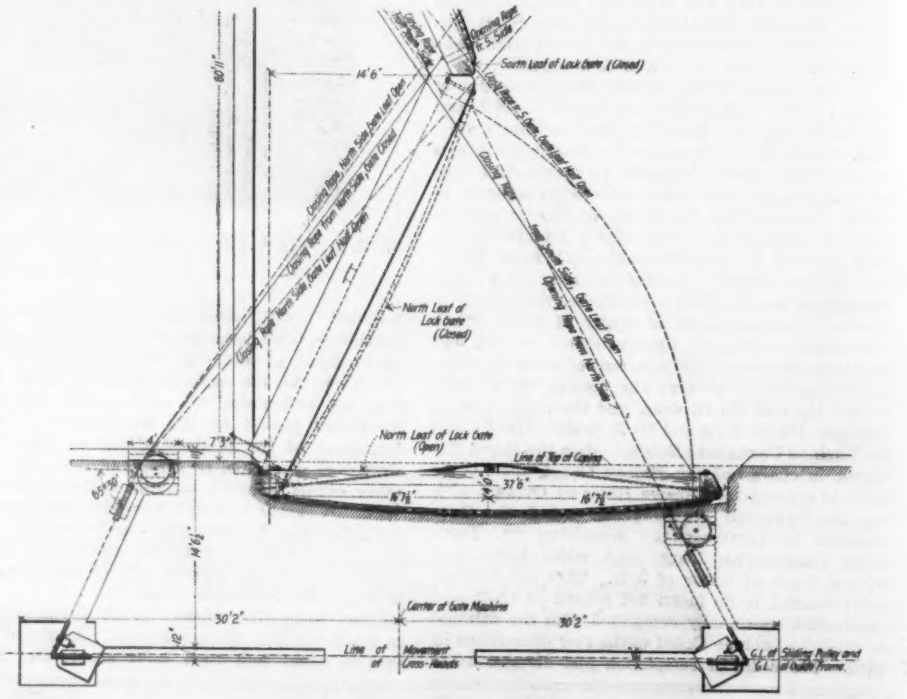

Opening Rear in S. Culv.
South Leaf of Lock Gate (Closed)
Closing Rear in S. Culvs. (open leaf Open)
Closing Rear, North Side, Open Leaf Open
Closing Rear, North Side, Gate Leaf (Closed)
Opening Rear from North Side, Gate Leaf Open
Closing Rear from North Side, Gate Leaf Open
North Leaf of Lock Gate (Closed)
North Leaf of Lock Gate (Open)
Line of Top of Coping
Center of Gate Machine
Line of Movement of Cross-Heads
C.L. of Sliding Bolts and C.L. of Guide Frame
60'0"
14'6"
7'3"
37'6"
16'7½"
14'6½"
30'2"

FIG. 6 PLAN SHOWING ATTACHMENT AND ARRANGEMENT OF CABLES OPERATING GATE LEAVES, SAULT STE. MARIE SHIP CANAL.

Gate Machinery.—The screw machine for operating the gates is shown in detail by Fig. 5 on the inset sheet, and is located at the point, X in Figs. 3 and 6. The motor operates the driving shaft Z (Figs. 3 and 5), and, by means of the transmitting spur Y, the shaft Z operates the spurs W and V, operating the screws and crosshead (Fig. 5). This crosshead has a travel of 8 ft. 9 ins., and carries a connecting rod at each end. These connecting rods have pulleys at their ends, which slide in guides (Figs. 5 and 6). The drawings show

the gate machines so much in detail that no further description is necessary.

Turning now to Fig. 6, the operating cables connect with the gate leaf at the miter post, and run to a horizontal pulley at the bottom of the well, then under a vertical pulley, then up the inclined well to another vertical pulley, and then around the deflecting pulley to the traveling pulley, operated by the gate machine. It will be noticed that the closing ropes are attached to the gate leaf opposite the side of the lock on which the screw-power machine is placed, while the opening ropes are attached to the leaf on the same side that the machine is placed. After the rope from the lock well reaches the traveling pulley, as

FIG. 7. VIEW OF WEST APPROACH TO LOCK SHOWING CONSTRUCTION OF REVETMENT WALLS AND CANADIAN PACIFIC RAILWAY CROSSING.

just described, it passes around one of its sheaves and back to a deflecting pulley at the top of the well, thence again to and around the second sheave of the traveling pulley, and thence to a standard, to which it is fastened by an adjusting screw. The four turns of the rope around the traveling pulley, which travels 8 ft. 9 ins., causes a travel of 35 ft. to the end attached to the gate leaf, and opens or closes the leaf by a single stroke of the crosshead. In all, there are six gate machines, one for each leaf of the upper lock gate, lower lock gate and auxiliary gate. A one-story wooden motor house covers each of the gate machines and its connecting motor.

With this machinery the time required to pass a vessel through the lock going upstream is, after the vessel has taken her place in the chamber, 50 seconds for closing the lower gates, plus 9 minutes for filling the lock, plus 50 seconds for opening the valves, plus 50 seconds for opening the upper gates, or 11½ minutes altogether. As the lock can be emptied in 7½ minutes, a vessel can be locked down in 10 minutes.

The machinery which has been described is, as far as we have been able to learn, the first electric power machinery ever used for operating the gates and valves of canal locks, and that it should for the first time be applied to a lock of this size and importance indicates the confidence with which this form of power, which was hardly considered manageable a decade ago, is now regarded. For both the old 1881 lock and the new 800-ft. lock on the American side of the St. Mary's River, hydraulic machinery is used. The reasons which led to the adoption of electric power on the Canadian lock are given in a letter from Mr. J. B. Spence, Chief Draftsman, Department of Railways and Canals, Dominion of Canada, as follows:

As regards economy, I think the difference between electric and hydraulic power would be very trifling, and here the point of economy was not taken into consideration. One of the main objects of using electricity was to overcome the great trouble caused by frost when hydraulic machinery is used. During the closing weeks of navigation the cold is so great that oil has to be used in the hydraulic engines placed on the lock walls, and even then the cold causes the oil to thicken and makes the action of the engines slow and tedious. Of course, frost would not have interfered with hydraulic valve engines placed at the bottom of the lock, but in this case eight engines would have been required, while only four screw power machines are needed with the machinery as designed. These considerations seemed to make it advisable to use electric power throughout, and I have every reason to think that everything will operate successfully when we open for navigation in the spring of 1895.

The approaches to the lock call for little description. Fig. 7 shows the west approach, and is practically a continuation of Fig. 1. The revetment walls are of masonry, resting on timber cribs, and, as will be noticed, the right, or north, wall has been strengthened by a buttress wall of concrete. This was necessitated by the sinking and bulging out of the crib work, due, it was thought, to the frost, the cribs having been built in the winter. Farther west will be seen the Canadian Pacific Ry. bridge, which, in its present form, blocks up half the width of the canal, and with its center pier is a wholly inexcusable construction for such a place. Only one 90-ft. channel is now available for boats, and when the plate girder span is removed, which would seem to be the probable intention—although such evidence as could be gained by inquiry on the ground went to show that this was not the intention—there will be added a second channel, also about 90 ft. It is to be borne in mind, however, that this bridge was not in existence when the canal was being built, but was built after the canal excavation had been completed, and when it was fully in the power of the government to require the construction of such a bridge as it pleased.

The lock, lock gates, power house and all the valve and gate machinery, except the turbines, dynamos and motors, were designed by Mr. J. B. Spence, Chief Draftsman, Department of Railways and Canals, Dominion of Canada, and the work of construction was carried out under the direction of Mr. Collingwood Schreiber, Chief Engineer, Department of Railways and Canals, Mr. William Crawford being Resident Engineer. The contractors for the lock and canal, except the portion under water, were Hugh Ryan & Co., Toronto, Ont. Mr. M. J. Maury, one of the members of the firm, was the Superintendent in charge of the work, and Mr. Wm. Birmingham was the engineer for the contractors. The contractors for the turbines were Wm. Kennedy & Sons, Owen Sound, Ont.

HOURS OF SERVICE OF ENGINEMEN, MIDLAND RY., ENGLAND.

The Midland Ry.,of England,has recently adopted a system for preventing overtime work by its engine drivers and firemen, which seems to involve much novelty. The British Board of Trade has been very severe of late years in its condemnation of the practice of permitting trainmen in responsible positions to work over hours. In every accident of which an investigation is made by the Board's officers, the number of hours which the men had been on duty at the time of the accident is always ascertained. The circular issued by the Midland Ry. explaining the system is as follows:

Notice to Drivers and Firemen.

When drivers and firemen have reason to expect that they will exceed twelve hours on duty before being able to book off, they must send a telegram on one of the printed forms provided for the purpose from the nearest station or signal-box, asking for relief. It must be addressed to the most convenient loco. depot, and must be despatched in sufficient time to admit of relief being provided where required.

Relief men are regularly kept at certain stations or sidings other than loco. depots, and where relief can be more readily obtained at one of these places, the telegram must be sent there, addressed to the stationmaster or foreman.

The men who relieve drivers and firemen will have passes supplied to go out with, and they must give them to the men they relieve to return with. All men must avail themselves of the best means of reaching the men they are sent to relieve, or of arriving at their destination to book off. They must—if necessary—travel by the first passenger train, or they may ride in the guard's brake van of a goods train, which stops near where they start from and at their destination.

If the men who have been relieved cannot obtain a pass, they must give their names and the station to which they belong to the guards of the trains they travel by, or to the ticket collectors, and they must make a special report of the case.

When booking off, the drivers must give full particulars as to their being relieved, and by what means they travelled to the shed.

Drivers must inform their guards when they wire for relief, and when the guards require relieving, their names, and the name of the stationmaster or goods agent to whom they wish to apply, must also be inserted in the telegram.

The tests, at Indian Head, of the Hurst multi-charge gun, described in our issue of Sept. 27, 1894, have been declared unsatisfactory. In a previous trial, noted on Nov. 15, 1894, with a powder charge of 184 lbs., a velocity of 2,452 ft. per second was obtained, with a chamber pressure of 15.8 tons. In that trial the projectile failed, it being too weak in construction. In the test of March 23, 185½ lbs. of powder were used; 10 lbs. in the inner case and 175½ lbs. packed about the tail rod forming part of the projectile. With the first shot the velocity was 2,088 ft. per second, and the mean pressure 10.75 tons. With the second shot these figures were 2,095 ft. and about 11 tons. The extreme velocity with minimum pressure which the inventor claimed was not realized.

WEATHER TABLE FOR FEBRUARY, 1895, (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Deg. Fahr.)				Wind.			Precipitation—rain or melted snow—inches.		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average.	Max.	Min.	Range.	Average.	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	13.8	41	—17	58	9.0	36	N	0.82	0.72	8
	Portland, Me.	19.7	40	—11	51	7.8	36	NE	0.94	0.50	6
	New York, N. Y.	25.2	48	— 3	51	13.1	43	NW	0.82	0.57	5
	Pittsburg, Pa.	22.8	60	— 6	66	8.3	31	NW	0.77	0.50	10
	Chicago, Ill.	17.0	61	—15	76	18.4	51	SW	1.60	0.91	6
	Omaha, Neb.	21.8	68	—20	88	8.3	32	NW	0.62	0.41	9
	St. Paul, Minn.	10 7	53	—26	79	7.7	29	NW	0.42	0.24	8
	Duluth, Minn.	12.6	58	—27	85	10.7	44	NW	0.48	0.11	9
	Bismarck, N. Dak.	9.5	64	—39	103	9.6	52	NW	0.35	0.26	9
	Average	17.0	53	—18	73	10.3	39		0.76	0.45	8
Southern Cities	Washington, D. C.	26.2	67	Zero	67	9.1	42	NW	1.10	0.54	6
	Louisville, Ky.	26.6	70	—10	80	8.2	36	SW	0.64	0.39	9
	St. Louis, Mo.	25.1	70	—12	82	11.6	36	NW	0.43	0.14	10
	Savannah, Ga.	42.8	78	12	66	9.7	42	NW	3.78	1.83	9
	Kansas City, Mo.	24.9	64	—12	76	9.0	38	NW	0.59	0.22	9
	Jacksonville, Fla.	47.6	76	14	62	8.3	33	W	3.61	1.70	7
	Chattanooga, Tenn.	33.8	73	— 2	75	7.8	40	NW	2.14	0.88	8
	New Orleans, La.	45 0	74	16	58	10.9	40	NW	3.92	1.25	12
	Memphis, Tenn.	34.6	74	— 3	77	7.1	36	NW	1.39	0.37	7
	Palestine, Tex.	40.0	76	— 1	77	7.8	30	NW	2.50	1.38	8
	Average	34.7	73	0.2	72	9.0	37		2.01	0.84	8
Western Cities.	Helena, Mont.	20.8	65	—17	82	6.2	40	SW	1.69	0.82	6
	Port Angeles, Wash.	42.2	67	27	30	5.0	36	E	1.72	0.41	12
	San Francisco, Cal.	52.8	69	41	28	7.1	31	W	2.39	1.44	6
	Salt Lake City, Utah	30.0	54	3	51	4.4	24	W	0.86	0.24	10
	Santa Fe, N. Mex.	37.2	54	—11	65	7.5	28	NE	1.20	0.60	5
	Denver, Colo.	26.6	63	—15	78	8.6	37	NW	0.48	0.25	9
	Yuma, Ariz.	60.6	84	38	46	7.5	28	N	0.02	0.02	1
	Average	37.3	64	9	54	6.6	33		1.14	0.54	7

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The appointment of Mr. North, a prominent member of the American Society of Civil Engineers, as Water Purveyor of New York, and of Mr. Stevenson Constable, a well-known architect and civil engineer, as Superintendent of Buildings, with the appointment of Col. Geo. E. Waring as Commissioner of Street Cleaning, commented on in these columns some weeks ago, is a strong indication that at last fitness for office is being recognized in these appointments in New York city. For a period beyond the memory of the present generation of citizens these offices have been held rather as rewards for political service, or as bureaus for the dispensation of patronage to political workers of lower degree. No engineer has ever before, to our knowledge, held the important office of Water Purveyor, for example, though the duties of that office in the issue of permits for the tearing up of streets, etc., is in its way as important as those pertaining to the bureaus of water supply and sewerage. We can heartily commend the policy of Mayor Strong and of Commissioner of Public Works Brookfield in placing all city work that has to do with engineering in the hands of competent engineers. The best men for these places must combine technical knowledge of the true requirements of their offices with executive ability to conduct the public business; and in these qualifications engineers, by reason of their experience and training, eminently excel. The recognition of these qualifications is a new departure in New York politics; but it is safe to say that the public will be so far benefited by the appointment of competent and proper officials to these offices that it will be difficult again to fill them with political workers, in accordance with the old-fashioned custom.

A somewhat novel departure in freight transportation is proposed on Lake Michigan by the establishment of a railway ferry service 260 miles long, probably the longest in the world. The scheme forms part of a new railway enterprise, the Wisconsin & Michigan, a line having its terminus at Peshtigo Harbor, on Green Bay, Lake Michigan, and which it is proposed to extend into the lumber and iron mining regions of Wisconsin and Michigan. Instead of attempting to make connections by new lines, or by traffic arrangements with existing roads, with the railways of the East, the promoters of the new railway boldly propose to run their trains upon ferryboats, built to withstand the storms and ice of the lake, and connect directly with these Eastern railways at Chicago. They will thus avoid all entangling alliances, and by landing at South Chicago further avoid the congestion of traffic incident to that city in its northern railway connections. Those interested in the ferry project have long experience in the handling of freight in the West, and the low rates at which iron ore is now transported from the Lake Superior region to Cleveland, and some previous experience in the bodily transfer of loaded cars have convinced them that the water transportation is cheaper under the conditions imposed. The chief consideration seems to be the use of boats strong enough to withstand the storms and ice of the lake at all seasons, and large enough to carry a paying load. The two boats now being built are designed with these objects in view, and they are to carry 28 loaded cars at one trip. The outcome of the enterprise will be awaited with considerable interest as another phase in the very old rivalry between water and land transportation.

Some very interesting negotiations are in progress between the authorities of Buffalo and the Niagara Falls Power Co. concerning the sale in Buffalo of power electrically transmitted from Niagara Falls. The Power Co. several weeks ago applied to the Buffalo authorities for a franchise permitting them to distribute and sell electric current in the city of Buffalo. The City Council has had the application under consideration since that time, and while no action has been taken, it has become quite plain that the free permit which the company asks for is not likely to be granted. The debates in the City Council have indicated that the city authorities are likely, in granting a franchise, to state a maximum rate which the company may charge for its power, and to limit the term of the franchise. There has also been more or less talk concerning the possibility of the city undertaking for itself the transmission and distribution of the current.

On Feb. 21, Secretary Rankine, of the Power Co., submitted a second proposition to the city. He stated that the company has found that it cannot economically transmit to Buffalo a less amount than 10,000 HP. If the city grants it the desired franchise, it will at once proceed to extend its wheel-pit 140 ft. and instal three more 5,000-HP. turbines and three 5,000-HP. dynamos, similar to those now in place. The company, however, will not accept a time limit to its franchise that is less than the term of its bonds, those now outstanding expiring in 1932. Neither will it accept a franchise with any restrictions in the rates which it may charge, claiming that the use of steam power or gas engines is a sufficient protection to its customers against the charging of extortionate prices.

As to the sale of power by the company to the city, at Niagara, the company offers the city its option of the following three plans:

(1) 10,000 HP. undeveloped on the company's lands, the city of Buffalo to make its own wheel-pits and side tunnels, $10 per 24-hour HP. per annum.

(2) 10,000 HP. developed on the shaft of turbines furnished by the company, $13 per 24-hour HP. per annum.

(3) 10,000 electrical HP., alternating current, at a voltage of 2,000 delivered on the company's lands at Niagara, $18 per 24-hour HP. per annum.

In case the city accepts either of these last-named propositions, the company will give it the benefit of its five years' study of the problem of transmission, and will arrange for the use by the city of the rights of way which it has acquired, three in number, between Niagara Falls and Buffalo. The company refused, however, to name a price for electrical power transmitted to the Buffalo city line, "as in the question of transmission are involved the uncertainties of the losses and costs of operation and maintenance."

The company further set forth, as proof that the prices it had named were reasonable, that it has a contract with a large electrical power company for the sale of 1,000 electrical HP. at Niagara Falls at "not less than $20 per annum." Concerning the cost of steam power, it quoted Mr. Louis H. Knapp, engineer of the Buffalo water-works, to the effect that the average cost for 1893 and 1894 of steam power for the water-works pumping engines at Buffalo was $77.55 per pump HP. In 1895 he estimates that it will be $62.04. At Milwaukee, the North Point pumping station of the water-works, where the famous Allis engine is installed, shows a cost per pump HP. per annum of $75.83, or per I. HP. of $68.25, and this being a city plant there is no expense for interest or taxes.

Just what will be the outcome of this deadlock between the city and the company it would be difficult to prophesy. It is extremely improbable, however, that the city will accept any of the company's offers of power or current at Niagara. On the face of things, if, after five years of study, the company is unable to make any estimate of the cost of transmitting current to Buffalo sufficiently accurate to warrant it in giving a price on current delivered at the city line, it is doubtful whether the city would do well to buy 10,000 HP. at Niagara Falls with the uncertainty as to whether it could transmit it at a price which would make its use profitable. It may be argued that this refusal to name a price on current delivered at the city line is merely a bluff on the part of the company to prevent the city from accepting its offers, and to force it to grant its request for an unlimited franchise; but even if this is the case, it is doubtful if the city authorities have power to undertake the purchase at wholesale and sale at retail of electric current, either at Niagara or at its own borders.

The question will probably come back, then, to the terms on which a franchise will be granted to the company, and on this point, unless real estate boomers exert their influence on public opinion, the council does not seem likely to yield the disputed points. The very evident fact is that hydraulic or electric power bids fair to be a drug in the market anywhere within a radius of 25 miles of Niagara in a few months; that is, there will be considerably more power developed than will be demanded by consumers. Buffalo, as the only great city in this area, is likely to find that several of these power companies are depending upon her patronage for an income on their investments, and that they will eventually be ready to make any reasonable concession to secure it. That it is difficult to arrive at a definite basis which will be fair to both parties must be freely admitted. On the one hand, the company's contention that it should be allowed to charge what rates it pleases for current, or, in other words, all that consumers will pay rather than use steam, seems unjustifiable; but, on the other hand, to fix a schedule of maximum rates that will be neither oppressive to consumers nor unjust to the company through a long term of years is wellnigh impossible. The best solution of the problem, apparently, would be to grant the company the desired liberty to make such rates as it pleases, but for a shorter term, say 10 to 20 years, which will leave an opportunity for the readjustment of rates on an equitable basis at the expiration of the franchise. The company's argument that its franchise must run as long as its bonds appears rather weak. Bonds already floated are supposed to be secured on the property already owned by the company. If it is proposed to float more bonds to build the transmission line to Buffalo, it would, of course, be proper to make such bonds expire with the Buffalo franchise. But the investment for this transmission line will not be so great that there should be any difficulty in floating short-term bonds at a fair price.

RATE OF EVAPORATION IN FIRE ENGINE BOILERS.

We publish in another column some very interesting records of tests on steam fire engines made for the city of Boston by Mr. Dexter Brackett, M. Am. Soc. C. E. Besides the value of these records as showing the capacity and economy of the several types of engines tested under various conditions, the tests are also of much interest in connection with the broad subject of steam boiler design. A great deal of attention is being paid nowadays to the design of boilers which shall give a maximum capacity with a minimum weight and space occupied. Such boilers are especially desired in marine work, for the equipment of fast

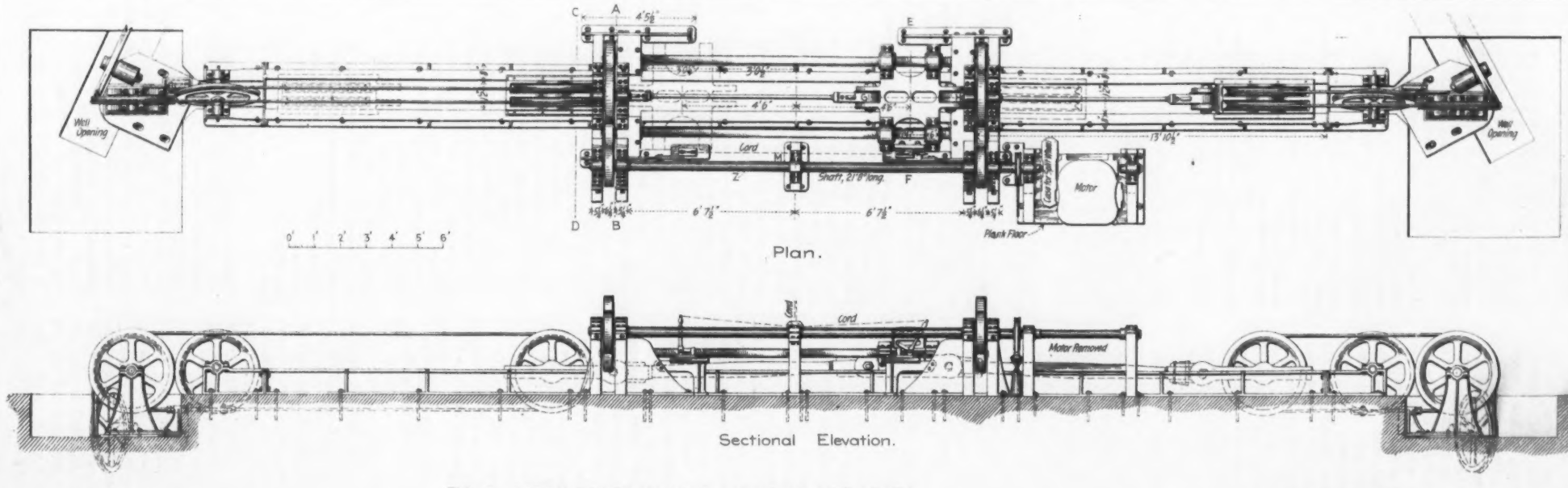


FIG. 5. SCREW POWER MACHINE OPERATING GATE LEAVES.

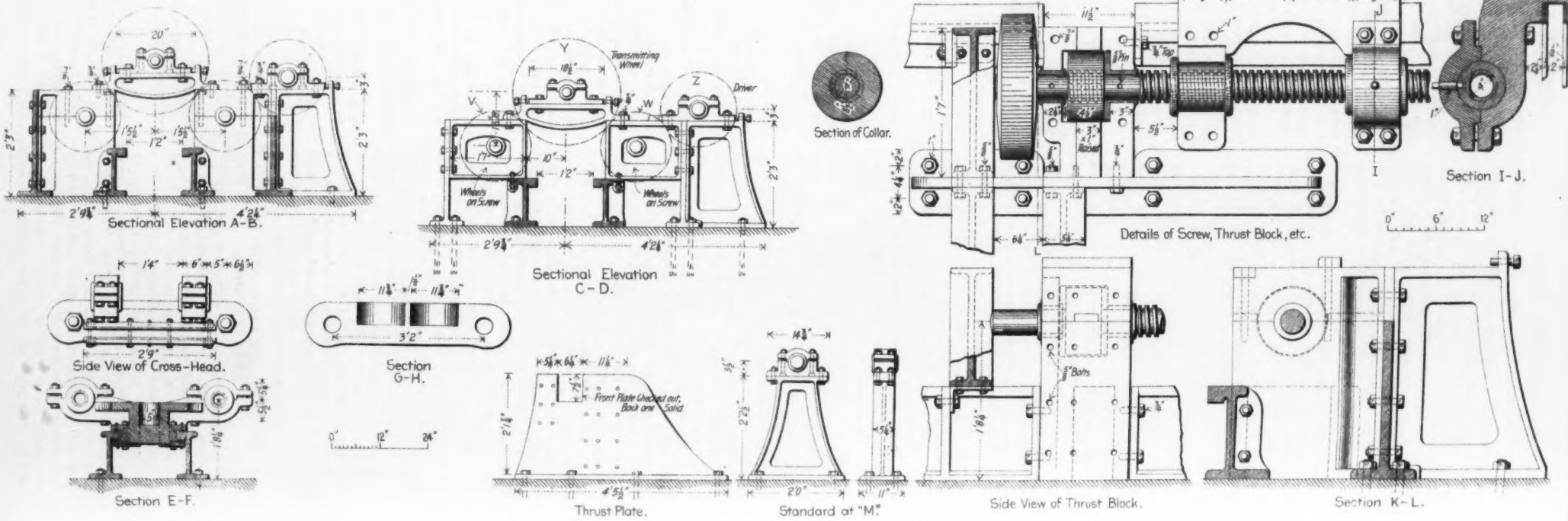


FIG. 5a. DETAILS OF GATE OPERATING MACHINE.

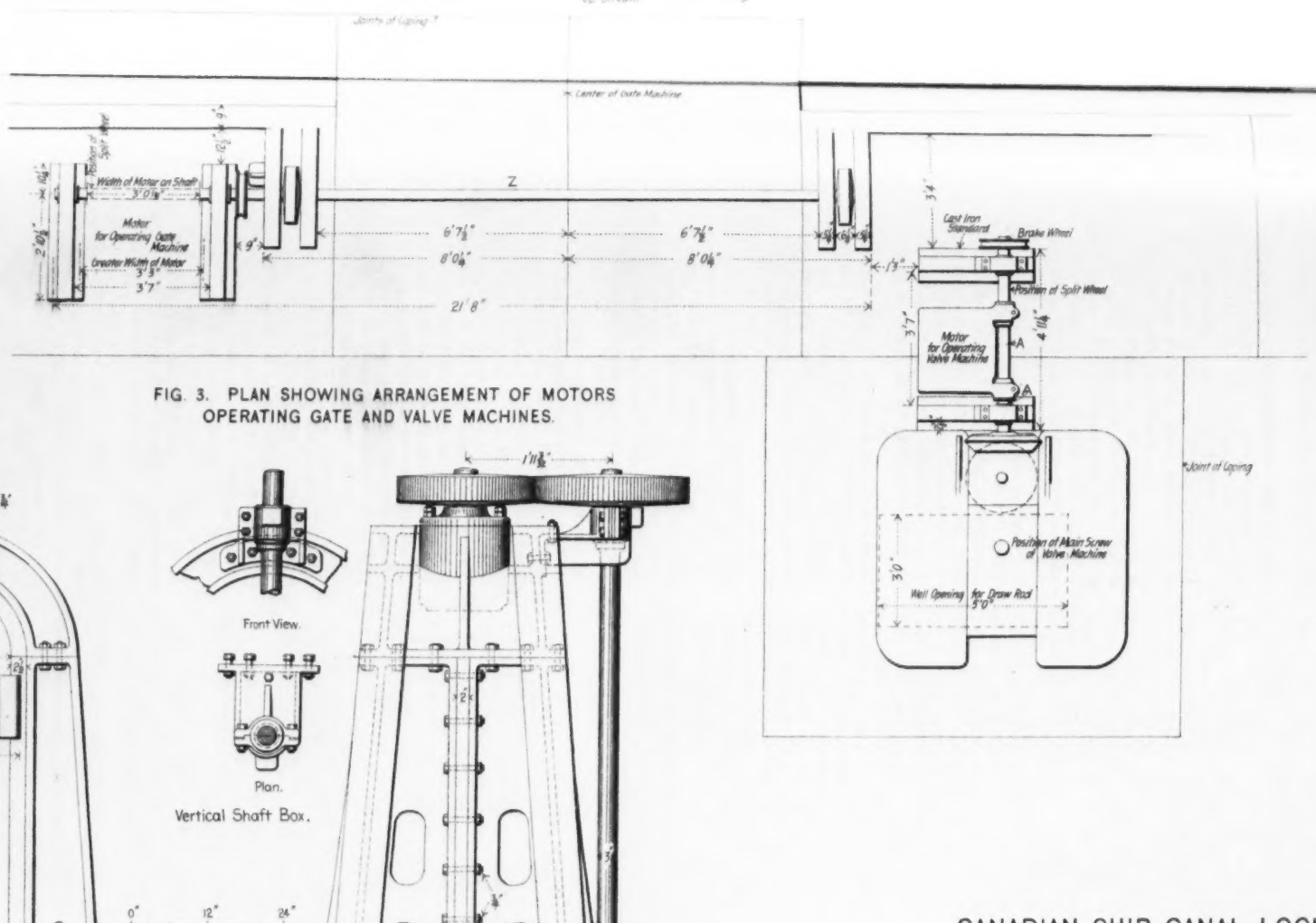


FIG. 3. PLAN SHOWING ARRANGEMENT OF MOTORS OPERATING GATE AND VALVE MACHINES.

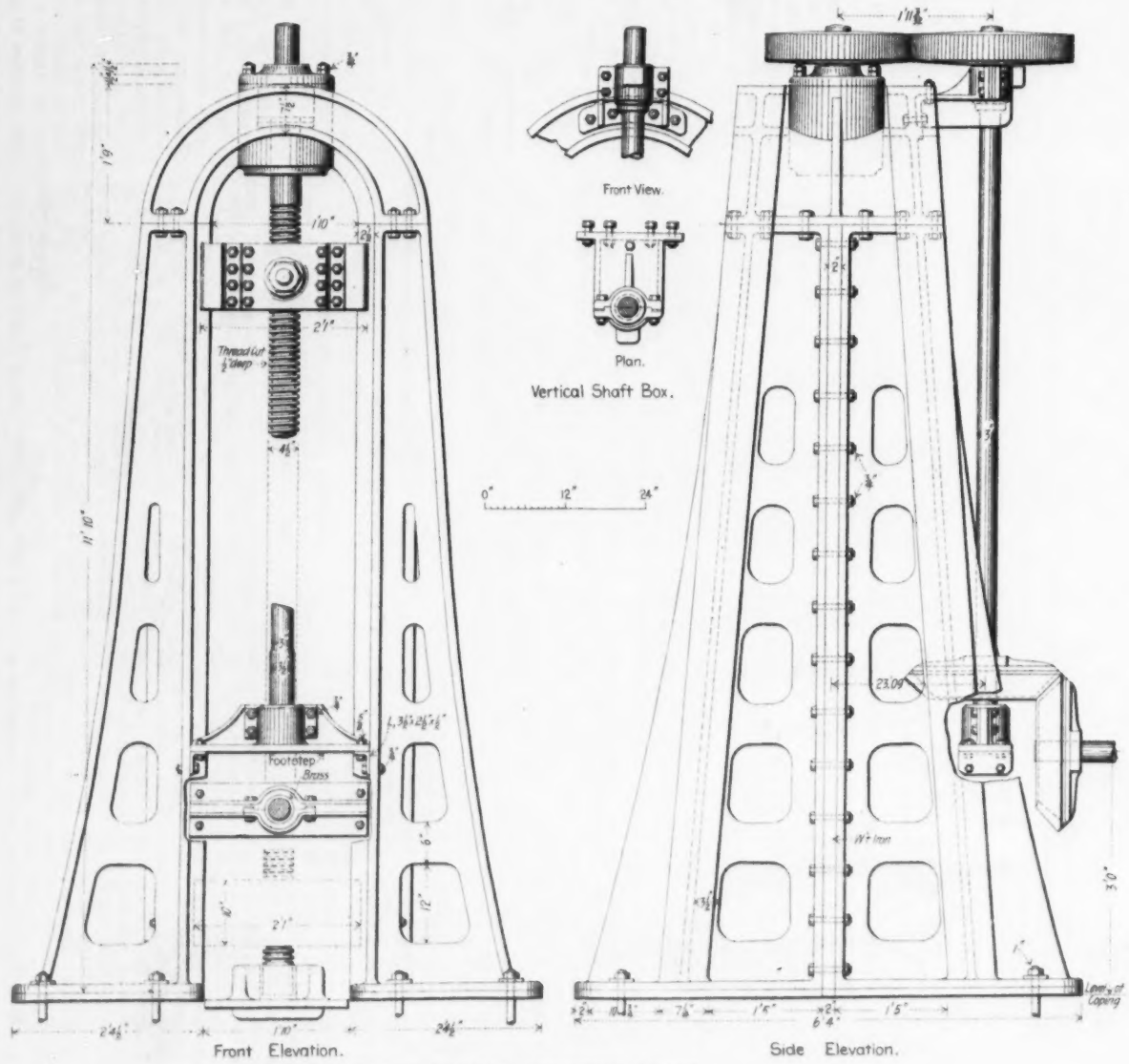


FIG. 4. SCREW POWER MACHINE OPERATING VALVES.

CANADIAN SHIP CANAL LOCK,
SAULT STE. MARIE, ONT.

Collingwood Schreiber, Chief Engineer,
Department of Railways and Canals, Canada.

John B. Spencer, Designing Engineer.

Hugh Ryan & Co., Contractors.

CHAS. HART & SONS, LITH., 38 VEREY ST., N. Y.

yachts, torpedo boats, torpedo catchers, naval launches, etc., but the possibilities in this direction are being attentively canvassed by those who are working on the problem of steam propulsion for carriages on common roads, and also by the enthusiastic inventors who believe it possible to combine lightness with power in a steam plant to such an extent as to make feasible the navigation of the air.

In addition, the action of steam boilers under high rates of evaporation is being studied with much interest by locomotive designers and by those designing stationary boilers for power plants in large cities, where space is so valuable that maximum power, with the least space occupied, is a consideration of much importance.

Now, there is, perhaps, no better example of a steam boiler forced to high capacity than the steam fire engine boiler. The accompanying table summarizes such results of the Boston tests as are of most importance to those interested in the general subject of boiler design. It is there shown that the coal consumption reached in one instance 208 lbs. per sq. ft. of grate per hour. One may get a more graphic idea of the rapid consumption which this represents by remembering that it is equivalent to a pound every 15 seconds; or by volume it represents an hourly consumption of a fuel bed 4 ft. in depth, or an inch in depth every 72 seconds.

The average rate of evaporation of the whole boiler reached 28½ lbs. per sq. ft. of heating surface per hour. Taking the average steam pressure as 85 lbs., this means a production of nearly 13 cu. ft. of steam per minute from each square foot of the heating surface, or a cubic foot in less than five seconds.

A convenient way to consider rates of evaporation is in terms of the number of heat units passing per hour through one square foot of heating surface. Supposing the feed water to be at a temperature of 60°, and the steam pressure to have been 85 lbs., we find that 32,872 heat units per hour per square foot of heating surface were transmitted.

It will be of interest to draw the contrast between this and stationary boiler practice. Here we find builders allowing 10 to 16 sq. ft. of heating surface per nominal horse-power, corresponding to an evaporation of 2 to 3 lbs. of water per sq. ft. of heating surface per hour or a transmission of 2,300 to 3,500 heat units. In "Steam," published by the Babcock & Wilcox Co., 5,000 h. u. per sq. ft. per hour is given as the maximum allowable rate of transmission in stationary boilers.

A comparison which presents the great steam-making capacity of these little boilers even more forcibly may be made as follows: Boiler No. 8 in the above table, only 3 ft. in diameter, 5⅓ ft. high and weighing 1,900 lbs., evaporated 3,524 lbs. of water per hour. In ordinary stationary boiler practice this would be a fair output for a horizontal return tubular boiler 6 ft. in diameter, 16 ft. in length, with 1,800 sq. ft. of heating surface, and a total weight of some 20,000 lbs. Such a boiler with its brick setting would occupy a floor space of about 10½ ft. in width and 20 ft. in length, or about 210 sq. ft. as compared with some 9 sq. ft. for the little fire engine boiler of the same steam-making capacity.

It may be of interest also to show the capacity of this little boiler in horse-power. Using the standard rating of 30 lbs. of steam at boiler pressures as equal to 1 HP. hour, it appears that the boiler developed in the tests about 117 HP. The average I. HP. developed in the steam cylinder was only 78, thus showing that the steam cylinder of the pump used about 45 lbs. per I. HP. It may be argued that the boiler did not really make so much steam, but that a good percentage of what is credited as evaporation is really entrained water carried over. The reports state, however, that calorimetric tests of the steam were made and showed on the average only 1.80 per cent. of moisture, a truly remarkable record, when the rate at which the boiler was forced is considered. Were the steam from this boiler used in a fairly economical engine, using, say, 18 lbs. of steam per I. HP. per hour, it will be seen that nearly 200 HP. would be developed. As the weight of the boiler is only 1,900 lbs., this is a weight of only 9½ lbs. per HP. It is interesting to compare this figure with that of some marine boilers of different types. The Danish protected cruiser "Geiser," of 3,157 I. HP., has boilers of the Thorneycroft tubulous pattern, especially designed for light weight. Their total weight, with appurtenances, is 90.8 tons.* The weight per horse-power is therefore 57.6 lbs. The British torpedo boat "Hornet," with Yarrow watertube boilers, showed 4,000 I. HP. on her trial, and her eight boilers have 8,216 sq. ft. of heating surface, and weigh 43 tons, or 21.5 lbs. per HP. The boiler of Maxim's flying machine (Eng. News, Aug. 30, 1894) weighs 1,000 lbs., and is claimed to develop 360 HP., which, if correct, gives a weight of a little less than 3 lbs. per HP. It uses gasoline as fuel, however.

Without taking space for further figures, it is probably safe to say that the fire engine boiler occupies as little space and weighs as little in proportion to its power as any type of steam generator at present in use. Of course, this great steam-making capacity is gained at the expense of fuel economy. The boiler-heating surfaces are constantly bathed in flame, and the gases are discharged at a temperature so high that half, or even two-thirds, of the heat of the fuel is thus wasted. Manifestly, therefore, the fire engine boiler is by no means a model for stationary practice; and tests upon it are chiefly of interest in connection with the design of boilers where reduction in space and weight are so important that fuel economy can be made a secondary matter.

The boilers tested at Boston were of three types. The Amoskeag boiler resembles an ordinary vertical tubular boiler in its general design. The Clapp & Jones boiler has curved coil water tubes suspended from the crown sheet of a vertical tubular boiler. The Silsby boiler consists of a short vertical tubular boiler, with a nest of Field tubes suspended from the crown-sheet. Each of these Field tubes has an internal circulating pipe extending from end to end.

Capacity and Economy of Boilers Tested in Boston Fire Engine Tests.

No. of eng.	Maker.	Time pumps were running, mins.	Total water evap., lbs.	Evap. per hr., lbs.	Dimensions of boiler. Heat'g surf., sq. ft.	Height, ins.	Diam., ins.	Weight, lbs.	Coal burned per sq. ft. grate surf. per hr., lbs.	Water evap. per sq. ft. heat'g surf. per hr., lbs.	Water evap. per lb. of coal, from and at 212°, lbs.
1....	Amoskeag	174	4,840	1,670	101.0	..	..	.....	191	16.52	2.26
2....	"	157	5,273	2,015	85.0	..	..	.....	191	23.1	2.66
3....	"	179	6,188	2,074	74.0	..	..	.....	142	28.57	3.57
4....	"	150	4,150	1,660	86.5	..	..	.....	138	24.95	2.88
4....	"	185	6,219	2,017	86.5	..	..	.....	208	23.34	2.72
5....	Clapp & Jones.	162	5,168	1,914	86.0	62	30	1,385	103	22.25	5.87
6....	" " " .	183	6,068	1,930	86.0	63	30	1,385	182	23.13	3.45
7....	" " " .	151	5,930	2,356	112.0	62	32	1,570	117	20.96	4.94
8....	" " " .	143	8,398	3,524	140.5	64	35	1,900	172	24.77	3.51
9....	Silsby	171	6,043	2,120	174.0	58	32½	1,500	142	12.13	4.49
10....	"	109	2,962	1,630	225.0	60	36	1,980	91	7.205*	4.22
10....	"	49	2,209	2,705	225.0	60	36	1,980	151	12.02	4.10
11....	"	120	5,555	2,777	229.0	60	36	1,980	148	11.13	3.76

* This abnormally low rate is explained by the fact that this boiler leaked steam very badly around the upper ends of the tubes, so much so that the steam pressure fell off, the draft was interfered with and the rate of combustion was much reduced. Later these defects were repaired, and, as shown by the next line, the boiler was able to develop a considerably higher capacity than in the first test.

*Notes on the Year's Naval Progress, July, 1894, p. 12.

LETTERS TO THE EDITOR.

EXPERIMENTS ON WIND PRESSURE.—CORRECTION.

Sir: Referring to the article on Mr. Irminger's recent experiments on wind pressure in your issue of Feb. 14, I notice that in formulas 1 and 3, Table I., the factor P has been omitted from the second term of the equation; also that the expressions $\frac{P}{P'}$ and $\frac{P a}{P'}$ on p. 110, should each be changed to $\frac{P_1}{P}$.

Respectfully, O. J. M.

New York, March 1, 1895.

A HIGHWAY BRIDGE LETTING.

Sir: I send you inclosed a notice of a bridge letting, in which please note the reservations in regard to rejecting the bids; I think it something unique in this line. Yours very truly, Hiram Phillips.

810 Olive St., St. Louis, Mo., March 15, 1895.

(We quote from the "notice" as follows:—Ed.)

The bridge is to be 40 ft. long, 14 ft. wide and on iron legs 12 ft. high, and the same will be let by contract publicly to the lowest responsible bidder at the hour of 10 o'clock a. m., on the 14th day of March, A. D. 1895, at Union Centre, Ill. Bids to be received and rejected from 10 o'clock until 12 o'clock, and if all bids are rejected bids will again be received and rejected at 1 o'clock p. m. A more complete description will be furnished of the material and work required by said commissioners of highways at time and place of letting.

THREE-CYLINDER LOCOMOTIVES; CORRECTION.

Sir: Mr. George B. Smith has called our attention to errors contained in the report published in your issue of Feb. 7 (page 93, second column) of the trial of the three-cylinder simple locomotives of the Erie & Wyoming Valley R. R. In the first table in the second column of p. 93, the weight of three-cylinder engine No. 35 is given as 110,010 lbs., whereas it should be 110,100, while the steam ports are given as 1⅝ × 13½ ins., which should be 1⅝ × 13½ ins.

In the third table (same column and same page) for two-cylinder consolidation engine No. 3, the weight of train, including engine and tender, is given as 1,350,300 lbs., but this should be 1,550,300. The highest smokebox vacuum in inches of water for consolidation three-cylinder engine No. 4, given as 5.87, should be 7.75; and the lowest smokebox vacuum in inches of water for consolidation two-cylinder engine No. 3, given as 7.75, should be 4.50 ins. These variations are comparatively unimportant, but we regret to advise you that our own copy of the report contained an important error in the second line of this same table, namely, that the total water used by the three-cylinder consolidation engine No. 4, which is given as 29,927 lbs., should have been 20,927 lbs. At Mr. Smith's request we write requesting that you will correct this latter error with such comments as may be necessary to put the performances of the three-cylinder locomotive in proper light before your readers.

Very truly yours, Burnham, Williams & Co. (Baldwin Locomotive Works).

Philadelphia, Pa., March 21, 1895.

(The error in the amount of water used will not have misled any one who has studied the article, as the total amount of water used is of comparatively little significance, and the error did not follow on into the following more important item of water used per hour.—Ed.)

WIND PRESSURE AND SUCTION.

Sir: In reading the article on Recent Experiments in Wind Pressure, in your issue of Feb. 14, I note some conclusions which to my mind are not quite sustained by the evidence produced. If we imagine a current of air passing over the surface of the "rectangular body" of the measuring instrument, there will be more or less friction between this moving air and that standing in the holes through which the pressure is to be communicated to the inside of this "body." This friction will tend to drag the air in the holes along with the moving current, thus drawing it out of the holes and producing "suction," to be measured by the gage inside the "body," while there may be nothing but pressure on the surface. The action I refer to may be illustrated by the current of air which follows moving water or a rapidly-moving belt. Such action would certainly be an appreciable factor, and until it is provided for, the results of the machine are, to say the least, incomplete.

Further we find the statement, "It is observed that the bird holds its wing at an angle of 6° with the horizontal; at this inclination the effort of the wind upon the under side of the surface is zero, while the suction acting on the upper side is equivalent to an upward pressure which sustains the bird." I have always understood suction as the difference of pressure between two sides of an object, and therefore to make it effective there must be pressure on at least one side. If this definition is defective I am still at a loss to imagine where the described action finds a point of application for its reaction, even supposing the air to be a medium through which this tension could be exerted.

Again, it is stated that where sails are placed at acute angles with the wind, the propelling force is suction. Such a force would naturally "belly" the sail to windward. I have had considerable experience in

sailing small craft and never observed any such phenomena. In fact, I never observed anything in this connection which was not perfectly in accord with the old-fashioned theory of resultant between sail pressure and centerboard or keel resistance.

Beverley S. Randolph.

Frostburg, Md., March 18, 1895.

A SIMPLE METHOD OF PREVENTING FIRE HYDRANTS FROM FREEZING.

Sir: Occasional published allusions to frozen-up hydrants and to the use of appliances for thawing out hydrants, suggest the query: Why should such things be?

Although residing in a place where the thermometer occasionally varies from 0° to 25° or 30° below zero for a week at a time, we have never had a frozen hydrant, and we test a few from time to time, to know where we are. When the writer took charge of the water-works here he reasoned on this question as follows: Our hydrant connections are 5 ft. deep (covered), but even a stone wall we do not consider beyond the action of frost (with a cold cellar behind it) if founded less than 6 to 8 ft. deep, and in Montreal the law requires 10 ft.; therefore, mere depth of 5¼ ft. (to center of pipe) is not enough protection for the dead water in a hydrant branch. Again, frost cases for hydrants are right in theory, but cannot be sufficient when we consider the conductivity of iron and the great exposure of the hydrant to extremes which must induce rapid and deep-reaching radiation. Consequently, the first precaution taken was to have every hydrant covered by an inverted barrel, as a makeshift in a time of extreme cold, and snow banked up about the base. The appearance was not pleasing, but the efficiency was ideal. Later a neat box was provided in two parts; a base low enough so as not to interfere with coupling hose to the nozzles, and which may be set or frozen into the ground; next the upper part or box proper, resting upon and overlapping the base, so as to be instantly removable. The expense was inconsiderable. Hydrants in a neighboring town were found frozen when most needed, allowing the fire to get great headway and cause much extra loss. Our hydrants were always found ready for action. The ground over the connection is also kept well covered with snow.

Of course, in cities and large villages, with paved streets much travelled, the benefit of snow banking cannot be had. In such cases more dependence must be put upon a greater depth of the hydrant branch and boxing made to fit the ground closely, so as to prevent radiation from the metal surfaces.

Doubtless this idea has been put in practice elsewhere, although the writer does not recall having seen it, and it should be more generally adopted.

Very truly yours, Robert Fletcher,
Assoc. Am. Soc. C. E.

Thayer School of Engineering, Hanover, N. H., Feb. 23, 1895.

TESTS OF DOUGLAS FIR.

Sir: Referring to the article on transverse strength of Douglas fir, by Prof. Charles B. Wing, in your issue of March 14, I desire to call attention to the fact that Prof. Wing has in this communication given us no information as to the percentage of moisture in the timber. Since the United States timber tests have thoroughly established the fact that the strength of timber increases rapidly as the moisture diminishes, especially when it is relatively dry, so that well-seasoned timber has about twice the strength of green timber, it is evident that no modulus of rupture can hereafter be received as indicative of relative strength, unless the percentage of moisture was obtained throughout the cross-section of the specimen at the time of the test. A failure to observe this function, which may cause the strength of the timber to vary by 100%, was an excusable oversight before the relation of strength to moisture had been so fully established and published in the Forestry Bulletins nearly two years ago. The absence of these data also makes all previous tests on the strength of timber of little or no value for comparative purposes.

It is about as important to determine the percentage of moisture of a piece of wood at the time at which a test is made of its strength as it is to determine the breaking load! We probably could guess at the breaking load more accurately than we could guess at the percentage of moisture, and the one is about as important as the other in determining the strength of the stick.

Prof. Wing has also failed to inform us from what portion of the large beams the small beams were cut. Apparently he cut one small beam from each large beam, and since these beams probably all failed in compression, it would be necessary to cut the small stick from the compression side of the large stick, in order to obtain comparable material for instituting a comparison of strength between large and small sizes. Furthermore, it would be necessary to make the tests on the small sticks the same day on which the large sticks were tested, in order that their moisture condition might be the same, and since the moisture condition is not uniform throughout the large stick it would be necessary to determine the percentage of moisture of the small stick as well as of the large stick, even though they were both tested on the same day, and the one had been cut from the other. Without all such data, we are not warranted in drawing any conclusions as to the relative strength of the small and large sticks.

From the diagram shown on your page 168, the small sticks give a much greater strength than the large sticks. This could be explained by supposing that the small sticks were drier. In the United States tests which have been made under my direction, in all cases where the large sticks were free from defects, and the moisture conditions were the same in both large and small sticks, we have obtained practically the same unit strength in the large beams as in the small. Our results lead us, therefore, to the conclusion that such relative weakness as is shown by tests on large sizes is due either to a greater percentage of moisture or to various defects in the large beams not found in the small beams, or to both. Probably the usual discrepancy is due to both these causes.

Very truly yours, J. B. Johnson.

St. Louis, Mo., March 16, 1895.

SANDBERG RAIL SECTIONS.

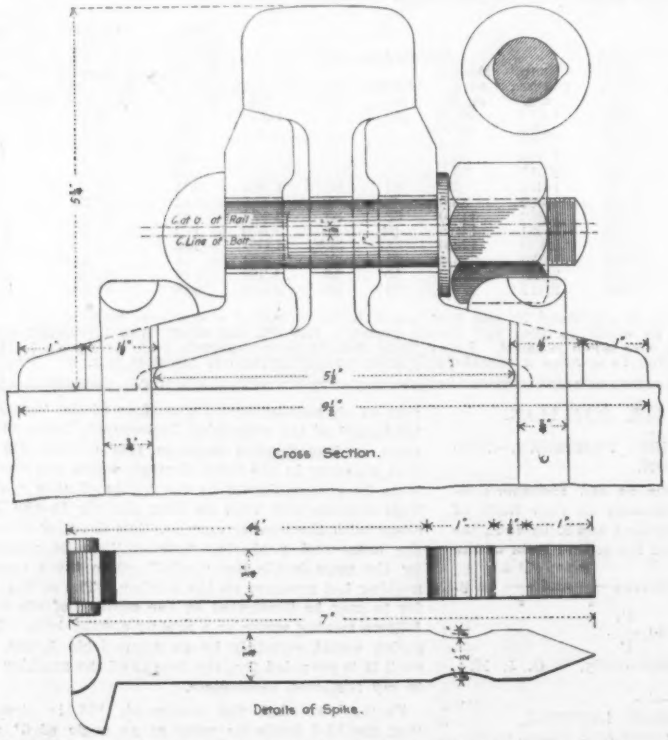
Sir: Inquiries having been made regarding the two Goliath rails of different weights, namely, the Sandberg standard of 100 lbs. per yd. and the Belgian State Railway section of 105 lbs., I wish to separate the two, so as to avoid confusion, inasmuch as there is not only a difference in weights and sections, but the whole design of the rail joints is different, and I now enclose drawings of the two. My rail was designed in 1886, and was published in my paper on "Rail Joints and Steel Rails" in the Minutes of Proceedings of the Institution of Civil Engineers, session 1885, 1886, and the Belgian rail was designed by the engineers of the Belgian State Railways shortly after. I was certainly the means of their adopting the heavy rail, but not having been consulted as to their design, of either section or rail joint, I must disclaim any merit or blame that experience may show to belong to them.

The Belgian State Railways are now almost completely laid with the 105-lb. rail, so that any one interested can soon form an opinion for himself, but it is not for me to criticise it. As for my own, it has done good service in the St. Clair tunnel of the Grand Trunk Ry. during four years, and has probably had more traffic than any other road laid with flange rails anywhere. In regard to the Barrow trial on the Furness Ry., in England, the road is laid with base plates fixed with keys and has now carried about 3,000,000 tons during four years, and the rail has not worn more than 1-16 in. (Eng. News, March 30, 1893). The rolling stock is lighter than that in Canada. The rail joints keep well up and the running is as smooth as, if not smoother than, on the English type of road laid by the side of it. The cost of the two tracks is about the same; a saving of cost was not however the object in view in making the experiment, but simply to show that as good a road could be got by heavy flange or T-rails as with the English type of road, and I am happy to say that so far as experience has yet gone this has proved to be the case.

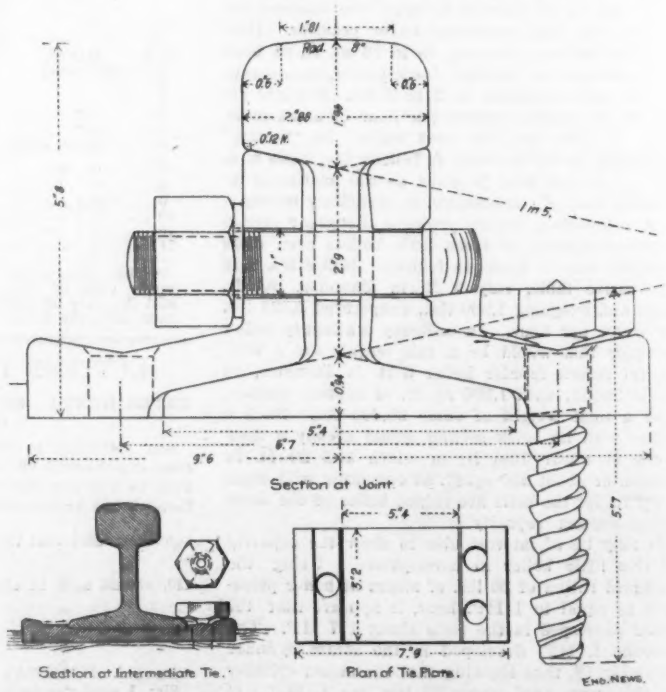
Yours truly, C. P. Sandberg.

19 Great George St., London, England, Dec. 19, 1894.

(There has been considerable confusion with regard to the Sandberg and Belgian "Goliath" rail sections, which this letter will tend to put straight. The Sandberg joint has broad-flanged angle-bars, 31¼ ins. long, with bolts spaced 10, 5¼ and 10 ins., and having spikes driven through holes in the flanges, these holes being ⅞ × 1⅛ ins. The bolts have kite-shaped necks fitting into corresponding



SANDBERG RAIL, 100 LBS. PER YD.



GOLIATH RAIL, 105 LBS. PER YD.; BELGIAN STATE RAILWAYS.

holes 1⅛ × 1½ ins. in the splice bar, while the other bar has oval holes 1⅛ × 1⅝ ins. The angle bars take a bearing on the ties, which are spaced 18 ins. c. to c. The Belgian joint has bars 29.2 ins. long, with extremely wide flanges, through which are passed screw spikes. On all intermediate ties grooved tie-plates are used, of the form shown. There are 12 ties to a rail length of 29.52 ft., the spacing being 24 ins. c. to c. at the joint, then two spacings of 28 ins., and all other ties 32 ins. c. to. c. The four track bolts are spaced uniformly 6 ins. c. to c.

NOTES AND QUERIES.

S. H. S., of Syracuse, N. Y., inquires for any biographical sketch of Col. O. W. Childs, at one time State Engineer of New York, and Chief Engineer of the Nicaragua Canal surveys made for Commodore Vanderbilt in 1850-51. He lived in Philadelphia at a later date, and was connected with the manufacture of the Woodruff sleeping car.

THE ARNOLD SYSTEM OF GARBAGE UTILIZATION AT BOSTON.

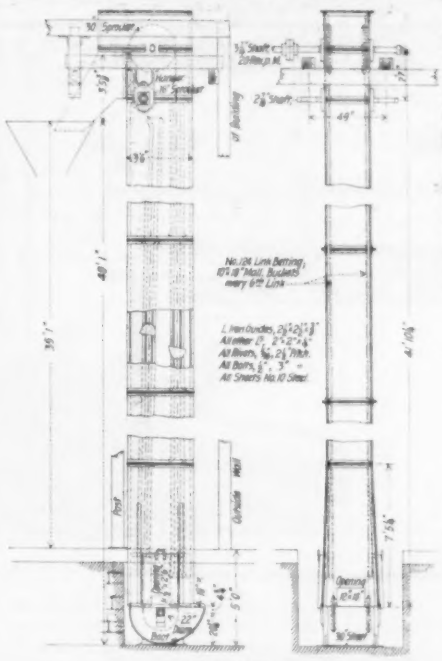
A garbage utilization plant has been in operation in Boston since early in January, under a contract for the disposal of 20 tons or more of material a day for a period of ten years, at $2,500 a year and 25 cts. a ton for any excess over the daily amount named. In this plant steam alone is used in the digestors for extracting the grease, thus avoiding the use of naphtha or similar reagents. Another interesting feature is the use of a garbage press for removing all possible moisture from the material before it passes from the digestors to the driers.

Up to the time of putting this plant in operation, all the garbage of Boston was disposed of, as nearly all of it still is, by feeding it to pigs and dumping it at sea. In 1892 and 1893 the Superintendent of Streets, then Mr. H. H. Carter, M. Am. Soc. C. E., investigated the subject of garbage disposal, as set forth in his reports for that year. In 1893 a "Joint Special Committee on the Disposing of City Offal," consisting of members of both branches of the city council, visited a number of garbage plants, held public hearings and submitted a report (City Doc. 91-1893). This committee recommended no plan, but passed resolutions to the effect that a change in the existing methods of garbage disposal was required in the interests of health, and that the Superintendent of Streets be requested to prepare estimates showing the relative cost of disposal by cremation and utilization. Mr. Carter, in his report for the year 1893, after discussing the cost of cremation at Lowell, Mass., and in an experimental plant at Boston, and assuming that cremation in Boston would cost 80 cts. a ton, presented the following conclusions:

The method of cremation must therefore be left to those cities and towns which from their size cannot produce offal enough to warrant the erection of a utilization plant.

Recommendations were made in last year's report concerning the best method of disposing in the future of the offal of the city of Boston. The experience and knowledge gained on this subject during the last year has not changed in any way the recommendations then made, and they are therefore renewed:

(1) All offal collected in the vicinity of the wharf where the present dumping-boat is located should be taken there and then towed to the sea. If new dumping-wharves are established, either in East Boston,



Side and End Elevation.

Charlestown, South Boston, or the North End, all the offal of these districts should also be disposed of at sea.

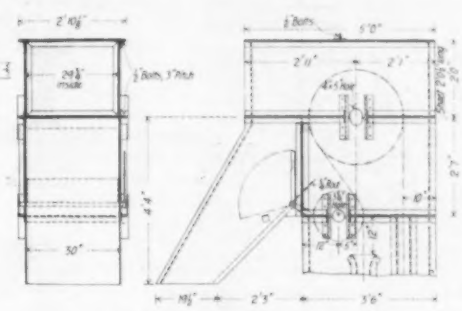
(2) A central place (such as the site of the old small-pox hospital at the South Bay or the site of the present offal house on Albany St.) should be selected and a plant erected for the disposal of offal by a utilization treatment.

It would be advisable to dispose of the offal of Roxbury, the South End, and parts of Dorchester, City Proper, and South Boston at this place. The amount of offal to be treated at this station would amount, at the present time, to about 130 tons per day, and would ultimately be increased to about 160 tons per day.

(3) As the erection of a utilization-treatment plant could not be undertaken unless a considerable amount of offal can be treated, it would be necessary to establish several small cremation plants: One to be located in Brighton, another in West Roxbury, and another in Dorchester, to cremate the small amount of offal collected in these districts.

By adopting the above-described system the greatest economy would be effected, as the offal would be disposed of in the vicinity where it is collected, and the expense of hauling the material long distances would be done away with.

In 1894 the city council took the garbage matter up with the idea, it appears, of contracting for the disposal of 160 to 200 tons of garbage a day. Negotiations were under way for closing a contract to this effect with the New England Construction Co., of 92 State St., Boston, but it was finally concluded to start out with a 20-ton plant. About the middle of 1894 a contract was closed with the company on the basis named in the opening paragraph of this article, and with the proviso that the plant should be removed and the contract be terminated if at any time the Board of Health should find it to be a menace to health or a nuisance to the neighborhood. The contract further provides that the garbage must be delivered to the plant free from ashes and rubbish, but not from the tin cans ordinarily deposited in the garbage barrels. The only condition that the work must fulfill is to dispose of the garbage in a sanitary manner, without creating a nuisance.



Details of Delivery Chute.

Fig. 2. Details of Link-Belt Garbage Elevator.

The site, it is stated, was selected by the Superintendent of Streets and approved by the Board of Health. It is in the Dorchester section of Boston, with dwellings and other buildings quite near by in all directions. It consists of 40,000 sq. ft. of land, rented by the Street Department from the School Commissioners for $200 a year.

The following description of the works has been prepared from information furnished by the various persons and firms named in this article, and from notes and observations made by a member of the editorial staff of this Journal at the plant on Nov. 22, 1894, while it was under construction, and also on March 20, 1895, when the plant was in full operation, and was visited by the Boston Society of Civil Engineers.

First, it may be said that the works are constructed under patents granted to Mr. H. B. Arnold, of Boston (No. 501,037 dated July 4, 1893). These

FIG. 1. GENERAL VIEW OF ARNOLD GARBAGE UTILIZATION PLANT AT BOSTON; New England Construction Co., Boston, Contractors.

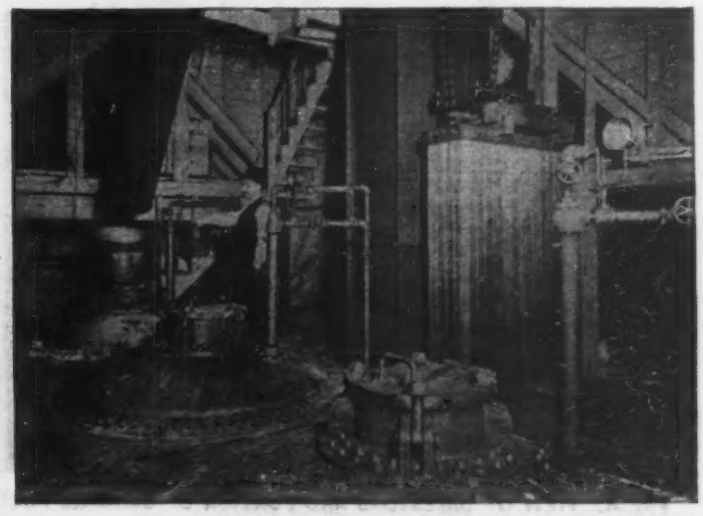


FIG. 3. VIEW OF TOP OF DIGESTORS AND PORTION OF LINK-BEL GARBAGE ELEVATOR.

patents are owned by the Sanitary Product Co., of Philadelphia, of which Mr. Clarence B. Kugler, 1405 Filbert St., is President. The New England Construction Co. has a license for this process covering the New England states and all of New York state except New York city and Brooklyn. Mr. W. C. Merrill is General Manager of the latter company, and Mr. John C. Soley was President of it at the time the contract with Boston was closed. Mr. R. S. Merrill was Superintendent of Construction, and Mr. Benjamin Dickerman is now President of the company. An experimental plant was operated under this process at Wakefield, Mass., for some time, and a permanent plant was used for a number of months at Washington, until destroyed by fire, while works with a daily capacity of 150 tons are now being built at Philadelphia for the American Incinerating Co.,one of the three contractors for the disposal of the garbage of that city this year. The Philadelphia plant is located at Morris St. wharf, on the Schuylkill River, in the outskirts of the city, but within the city limits. Its construction, Mr. Kugler states, is now well under way.

The claims of the Arnold patent are for a sanitary process of city garbage disposal and recovering the useful products therefrom, consisting of cooking the garbage or subjecting it to the direct action of steam for from four to eight hours in a closed vessel, and condensing the arising vapors; then separating the grease, tankage and water, subjecting the tankage to pressure to separate more water, and finally drying the tankage in a closed drier and condensing the vapors thus produced. Mr. Arnold had long been connected with the rendering and fertilizer business before turning his attentoin to the treatment of garbage.

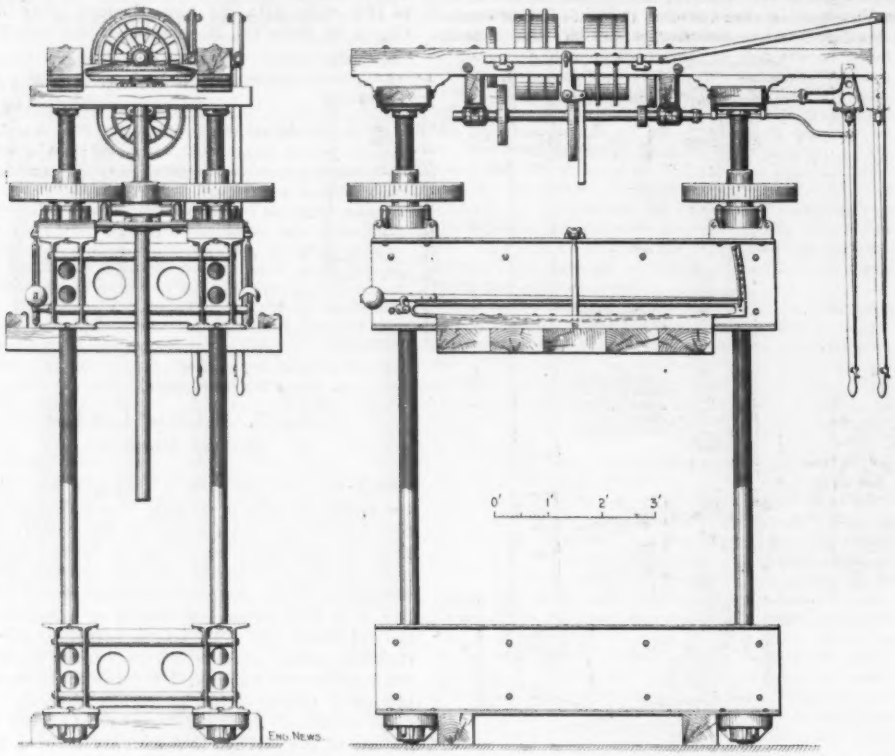


FIG. 5. ELEVATIONS OF BOOMER & BOSCHERT'S GARBAGE PRESS.

Upon arriving at the Dorchester works the garbage is first weighed just outside the small office building shown at the extreme right of the general view of the plant, Fig. 1. It is then drawn up a slight incline into the receiving room at the right of the main building, Fig. 1, and shoveled from the wagons through a trap door to a sloping platform below. Here tin cans are picked out and thrown into a washing vat, provided with a supply of cold water and steam, chloride of lime also being used as a disinfectant.

The garbage is pushed from the receiving platform down into the vertical elevator, shown in detail by Fig. 2, and also in part in the view, Fig. 3. This elevator is known as the "perfect discharge" elevator, and is made by the Link Belt Engineering Co., of New York and Philadelphia. It extends nearly to the high central roof of the main building, and discharges the garbage through a long, swinging iron or steel chute into the top of any one of the three digestors, as shown in the view, Fig. 3. A full-length view of the digestors, with the exception of their tops, is shown by Fig. 4. The digestors are of ⅝-in. steel, about 6 ft. in diameter and 15 ft. high, including the conical bottom, which has a grating at its inverted base on which the garbage rests. One of the digestors being filled, its cover may be fastened down, and the garbage is then literally cooked with water or steam, or both.

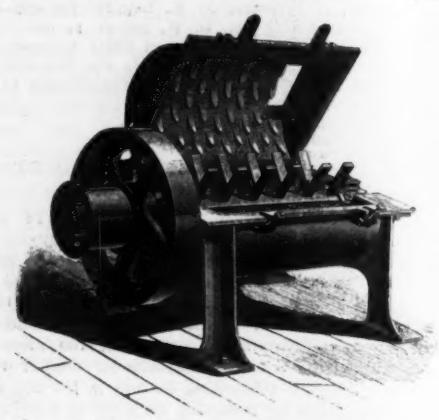


Fig. 6. Anderson Garbage Picker.

The grease and water from the digestors, the press, and the floor washings are conveyed to catch-basins, from which they are pumped to a vat having two partial partitions. The water flows beneath one partition, over the second, and out through a siphon draining from the bottom of the tank. The grease goes into two other tanks, one above the other, where any remaining water is excluded by the aid of steam, after which the grease is barrelled.

Each tank is provided with an Anderson deodorizer, made by the V. D. Anderson Co., of Cleveland, which also furnished the drier. The deodorizer consists of a small T, into one arm of which the steam from the digestor is passed to be met by a condensing current of cold water from the

FIG. 4. VIEW OF DIGESTORS AND PORTION OF GARBAGE PRESS.

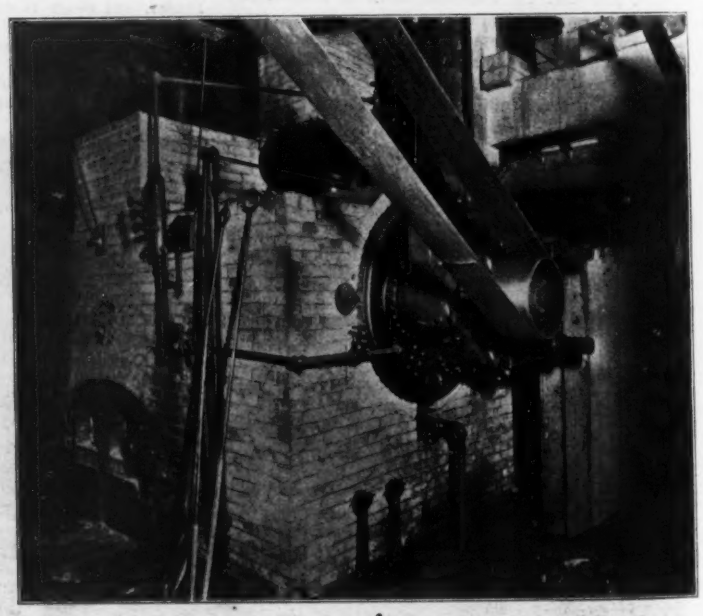


FIG. 7. VIEW OF ANDERSON GARBAGE DRIER.

vertical part of the T before it passes to the sewer through the other arm. The wearing parts are made of bronze and an air chamber (it appears from the cuts in the company's catalogue) is provided opposite the leg of the T.

The tankage is raked out through the door just above the conical part of the digestors into the inclined chute, as may be seen in Fig. 4, and onto the press platform car, where a form is built up for pressing with the aid of gunny sacking and wooden racks to separate the garbage into layers. The car is pushed along a track and onto the platform of the press, one end of which is shown in the view, Fig. 4, and of which two elevations are given in Fig. 5. One man is required to haul the garbage from the digestor, and one, at least, to build up the press form. The press was made and put in by the Boomer & Boschert Press Co., of Syracuse, N. Y., who were represented at Boston by Mr. Wm. A. Lawrence. This company manufactures presses for a large variety of purposes, and has many tankage presses in use at rendering establishment. Mr. R. E. Boschert, President of the company, states that about 3 HP. is required to drive the press, on the average.

FIG. 8. AGITATON SHAFT FOR GARBAGE DRIER.

The steam used for power and for the digestors is generated by a 48-in. Manning boiler of about 100 HP., rated to carry 125 lbs. of steam. This boiler was built by the Phoenix Iron Works Co., Meadville, Pa., and furnished through their New England agent, the Davidson Ventilating Fan Co., Oliver and Milk Sts., Boston. A 40-light electric plant was also furnished by this company. The engine is an automatic self-contained Atlas engine, with a 10 × 12-in. cylinder, rated at 43 HP., at a speed of 225 revs. per minute. It is fitted with an automatic shaft governor and balanced slide valve. It was furnished by J. H. Houghton, 201 Congress St., Boston, agent for the Atlas Engine Works, of Indianapolis, Ind. The engine house is of brick, and is shown in the foreground of the view, Fig. 1.

When the tankage comes from the press it is pushed on the car up to an inclined belt elevator, from the top of which an endless belt conveyor leads to the drying room, a separate building shown in part at the left of the brick engine and boiler house in the view, Fig. 1.

The conveyor discharges the pressed garbage onto a small sorting platform, where hard foreign substances are thrown out by hand, and the garbage is fed into an iron picker, shown by Fig. 6. From this picker a link-belt elevator, a few sections of which are rather dimly shown at the right in the view, Fig. 7, lifts the picked tankage to a hopper at the right end of the drier. The drying is done in three cylinders, each fitted with revolving agitator and conveyor shafts provided with steel paddles, as shown by Fig. 8. The shafts are in four segments of wrought iron, riveted together. One shaft is driven by a pulley at the feeder end, as shown in the view, Fig. 7, and the remaining two are driven by pulleys at the other end, all the pulleys being 9 × 16 ins. and designed for a speed of 200 revs. per minute, which seems to be a high speed for this use.

The cylinders are 18 ins. in diameter and 16 ft. long. The tankage is fed into the top cylinder, passes through it, then through the middle cylinder to the front again, and finally through the lower one to the back end, making a travel of 48 ft. Dust receivers are placed at each end of the drier, and an exhaust fan and condensor are provided for disposing of any objectionable odors or gases. The condenser is at the rear of the drier, and consists of a tube about 12 ins. in diameter and some 7 to 9 ft. in length, provided at intervals with some half-dozen water-spray jets placed in the center of the tube and discharging downwards, thus bringing the cold water into contact with the steam or other gases.

The height of the drier to the top of the dust receivers is about 12 ft., and the width and length over all about 8 and 22 ft., respectively. The shipping weight of the drier proper, including its steam-making plant and all accessories, is 16,000 lbs. Its capacity is 600 lbs. of dry stock per hour from well-pressed tankage. Its grate surface is 13 sq. ft. and its coal consumption, the manufacturers state, is about 50 lbs. per hour of the ordinary soft coal used at Cleveland, O. About 15 HP. is required to drive the drier, and 5 HP. for the picker and exhaust fan. Power for this purpose is supplied by the engine already described.

The drier and accessories complete were furnished and erected by the V. D. Anderson Co., of Cleveland, O., with Mr. F. B. Anderson in charge. This company manufactures various styles of driers and allied appliances for treating tankage.

From the drier an elevator lifts the material to the second story, and delivers it onto a screen. The screenings are ready for bagging and sale, and the tailings are ground in a Foos mill before shipment.

The floors of the digestor and press room and of the sorting room are of cement. The floor of the receiving room, where the carts enter, is said to be of two layers of boards, with cement between.

So far as could be judged from an hour's visit to the plant when in full operation, everything is carried on a thoroughly sanitary and unobjectionable manner. The garbage is passed into the digestors as soon as unloaded from the wagons. These are air-tight, so the garbage can give no offense before or during treatment, providing the deodorizers properly treat the gases from the digestors. No evidence to the contrary appeared at the works, and there seems to be no reason why there should be any difficulty at this point. In the digestor and press room there was a decided odor, reminding one of burnt molasses candy, but this was not observed outside the building, although all the doors were open. In the drying room, and also in the screening, drying and bagging room the odor was even less noticeable.

It is reported that some two or three days before the first load of garbage was taken to the works, but just about the time they were to be put in operation, some of the people in the vicinity complained to the Board of Health that the odors from the plant were intolerable. This incident is cited for the double purpose of showing the utter groundlessness of many of the complaints against garbage disposal works, and the fact that opposition is to be expected, even if groundless, when such works are located in residence districts.

THE EFFICIENCY AND CAPACITY OF STEAM FIRE ENGINES.

The modern steam fire engine boiler reaches a consumption of coal per square foot of grate surface as great, probably, as any form of steam boiler. At the Centennial Exposition, in 1876, a series of pretty careful tests of fire engines was made, and some valuable information brought out, and previous to that a much less extensive series of tests had been made at the International Exhibition, held at London, England, in 1862. Until recently, these tests have been the only records of trials made by competent experts, upon which a critical opinion of the economy and duty of these machines could be based. In the fall of 1893, however, the Board of Fire Commissioners of the city of Boston, Mass., authorized the prosecution of a large number of tests of steam fire engines, the results of which are now available and form a valuable addition to the previous experiments. The results of these tests were given in the report of the City Engineer of Boston for 1893-4, and these of principal interest to engineers we have abstracted in this article.

The tests were conducted under the direction of Mr. Dexter Brackett, M. Am. Soc. C. E., Assistant Engineer, and their primary object was to determine, as nearly as practicable, the capacity and efficiency of the engines used by the Boston Fire Department, under conditions similar to those actually occurring at fires.

Apparatus and Method of Tests.—The engines to be tested were connected with a Post hydrant on an 8-in. main, connecting at a distance of 240 ft. with a 12-in. main. This hydrant had an inside diameter of 6¾ ins., with three outlets for hose connections, two 4½ ins. in diameter and one 2½ ins. in diameter. The engines were connected with one of the 4½-in. outlets by means of an ordinary 4-in. suction hose. The water-pressure at the hydrant was 42 lbs. per sq. in. when the engines were not drawing.

The hose used was new Callahan jacket hose, having nominal diameters of 2½ ins. and 3 ins., but the actual inside diameters were 2.65 ins. and 3.3 ins. The length of hose used for each line was generally 500 ft., except when using the large Siamese nozzle, in which case it was 200 ft. During some of the first tests the lines were 400 ft. long. Standard smooth nozzles were used in all tests, with a single exception, when a test was made to show the comparative efficiency of smooth and ring nozzles. The quantity of water discharged by the engines was calculated from observations of the pressure, made by means of gages attached to piezometers at the base of the play pipes, using the formula deduced from the experiments of Mr. J. R. Freeman.* Careful measurements were made of the diameters of the nozzles, and in nozzles of the same nominal diameter there was found a variation of 0.14 in.

The tests were conducted in the following manner: Steam was first raised in the boiler to a pressure at which the engine could do practical service, and then the fire was drawn and a new fire started with weighed fuel. As soon as the steam pressure began to rise, the engine was started and run with as nearly as possible a uniform steam and water pressure. Changes in the conditions were made at periods of from 15 minutes to 30 minutes, either by changing the sizes of the nozzles, the steam pressure, or the length or size of the lines of hose, the object of the tests being to ascertain the quantity of water which each engine was capable of throwing continuously, and not the quantity which it was possible to discharge through a short line for one or two minutes. Observations of the steam and water pressures at the engine were made every minute and of the water pressures at the nozzle every 30 seconds. All coal used under the boilers and all water fed to the boilers were carefully weighed. Pressures were taken on the supply main at the base of the hydrant, on the 2½-in. outlet of the hydrant, and at a piezometer attached to the 4½-in. outlet, with which the suction pipe from the engine was attached. These pressures were taken to show the loss of pressure by friction in the hydrant and the available pressure in the engine suction. The number of revolutions made by the engines was electrically recorded.

In order to obtain information in regard to the effect of a hydrant supply, as compared with drafting, two engines were tested drafting their water.

The tests were made on four sizes of Amoskeag engines; three sizes of Clapp & Jones engines, and two sizes of Silsby engines, as shown in Table I. Table II. gives the lengths of the trials, average steam and water pressure at the engine, the quantities pumped, coal used, water evaporated, etc.; and Table III. shows, somewhat more in detail, the results obtained from each engine under different conditions.

Results of Tests.—Referring to the individual

* Trans. Am. Soc. C. E., Vol. XXI.

tests, several interesting deductions can be drawn from the figures given in Table III. and from the still more detailed tables given in the report. It was found, in testing the Amoskeag engine No. 1, that, with a strainer on the suction pipe, there was a loss of from 3 lbs. to 4 lbs. in pressure between the hydrant and the suction chamber of the pump. With the strainer removed, the pressure was practically the same at both points. A comparison of the hydrant and drafting tests with the same engine seems to indicate that, with the same steam pressure the water pressure at the nozzle will vary directly as the hydrant or supply pressure is increased or diminished.

In testing the Amoskeag engine No. 2 and the Clapp & Jones engine No. 8, a series of steam indicator cards were taken at intervals of about ten minutes. From these cards the following results have been deduced:

Engine No. 2.*				Engine No. 8.			
Revs. per min.	Total I. HP.	HP., pump measure.	Efficiency, per ct.	Revs. per min.	Total I. HP.	HP., pump measure.	Efficiency, per ct.
312	29.35	28.0	88.6	294	84.86	64.9	76.5
324	35.00	29.8	85.2	300	84.15	60.9	72.4
318	34.26	30.0	87.5	304	85.88	60.9	70.9
306	29.71	25.8	87.0	262	59.75	41.2	69.0
303	28.88	24.9	86.3	294	83.21	57.8	69.4
318	32.12	28.6	89.0	315	61.08	0.2	65.1
350	42.43	26.1	61.3	326	79.46	47.7	60.0
324	34.9	30.5	87.5	348	85.05	47.6	56.0
322	26.5	25.8	97.3	336	85.98	53.2	61.9
289	38.90	33.6	86.2	330	59.41	43.9	74.0
306	34.24	32.5	95.0	346	83.90	54.4	64.9

Studying these figures of efficiency, in connection with the figures of evaporation and fuel consumption given in Table II., it will be seen that the steam fire engine is far from being an economical pumping engine. Further evidence of this will be found in the figures giving the duties of the several engines. The amount of coal consumed per HP. per hour varies according to these figures from a little over 14 lbs. to nearly 34 lbs.

From Table II. it will also be seen that the consumption of coal per square foot of grate surface per hour runs very high, fully as high as the maximum consumption on railway locomotive engines in this country. The evaporation per pound of coal, of course, falls far short of average locomotive practice, notwithstanding the much better quality of fuel used with fire engines. This would naturally be expected, considering the excessive consumption of fuel per square foot of grate and the very short length of heating surface between the furnace and the stack. With fire engines, however, a big evaporative economy is, of course, a matter of small importance, the important points to be obtained being portability combined with maximum power to deliver immediately and continuously a large stream of water under high pressure, without regard to fuel consumption.

It will be seen, from the last column in Table III., that engines Nos. 1, 2, 5, 6 and 8 equalled or exceeded their calculated capacity at 300 revolutions per minute for runs of from 35 to 89 minutes, and that the average amount pumped per minute by engines Nos. 1, 5 and 6 for the whole time while the pumps were working was in excess of their calculated capacity. The results given in regard to the coal burned and water evaporated in Table II. show that steam was more easily made and maintained by the Clapp & Jones boilers than by the Amoskeag boilers. The evaporation per pound of coal from and at 212° varied from 2.26 lbs. in engine No. 1 to 5.87 lbs. in engine No. 5. The slip or loss through the valves and pistons of the pumps varied from 3% to 8% of the calculated displacement of the pump plungers. Engines Nos. 1 and 5 showed a loss of about 5% when taking their supply from the hydrant and 8% when drafting.

In connection with the engine tests several experiments were made to show the comparative value of 2½-in. and 3-in. hose and the effect of using 2½-in. couplings on 3-in. hose. The results are given in the accompanying table.

In the first three experiments, given in this table, two lines of hose, each 500 ft. in length, were attached to a steamer, and nozzles of the same diameter attached to each line. With the same pressure at the steamer, the pressures at the

Diam. of nozzle, ins.	Water pressure, lbs., at Nozzle of Engine.	3-in. hose.	2½-in. hose.	Discharge, galls., 3-in. hose.	2½-in. hose.
1¼	128.1	55.0	39.2	347	293
1⅛	124.5	57.5	43.0	355	307
1⅛	96.8	50.7	38.5	268	234
1¼ and 1⅛	110.9	44.0	44.5	311	257
1¼ and 1⅛	90.4	41.2	36.7	301	228
1¼	217.5	105.0	....	479	...
1⅛	221.4	....	75.5	407	...
1¼	219.5	101.5	....	472*	...
1⅛	204.0	96.5	....	460	...
1¼	158.6	71.0	....	395	...
1¼	151.6	68.2	....	387	...
1¼	224.0	....	74.7	...	405
1¼	157.4	....	51.2	...	335
1¼	151.1	....	48.7	...	327
1¼	124.1	....	39.7	...	295

* 3-in. hose with 2½-in. couplings.

nozzles on the 3-in. lines of hose were from 12 to 15 lbs. greater than on the 2½-in. lines. In the fourth and fifth experiments, 1¼-in. nozzles were used on the 3-in. hose and 1⅛-in. nozzles on the 2½-in. It will be noticed that the effective pressure at the 1¼-in. nozzle on the 3-in. hose was as large as at the 1⅛-in. nozzle on the 2½-in. hose, while the discharge from the nozzles on the 3-in. hose was between 20% and 25% more.

A comparison of experiments 6 and 8 shows the effect of using 2½-in. couplings on 3-in. hose, and it will be noticed that, with the same pressure at the engine, the nozzle pressure is about 5 lbs. less when using the 2½-in. couplings, or for a 500-ft. line of hose about ½ lb. loss at each 2½-in. coupling, when discharging 475 gallons per minute.

The loss of pressure per 100 ft. in the different sizes of hose is approximately as follows:

	250 gallons per minute.	300 gallons per minute.
2½-in. hose	13 lbs.	18.0 lbs.
3-in. hose, 2½-in. couplings	8 "	10.7 "
3-in. hose, 3-in. couplings	8 "	10.5 "

The report continues:

The advantage of using 3-in. hose is illustrated by the following example: With a steamer using a line of hose 600 ft. in length, with 1¼-in. smooth nozzle discharging 300 gallons per minute, a quantity none too large for the needs of the present fire service, a water pressure of 150 lbs. at the steamer would be required if 2½-in. hose were used, while with a 3-in. hose the same results would be attained with a pressure of 105 lbs. at the steamer. The advantage of the use of 2½-in. couplings would be that no time would be lost in attaching reducing couplings or in finding hose of the needed size, while the loss of pressure due to the 2½-in. couplings would be insignificant in ordinary use. Without doubt the 3-in. hose is not so easily handled on ladders or in buildings, but great benefit could be derived by using from 300 to 500 ft. of 3-in. hose from the steamer, with one or two lengths of 2½-in. hose attached for the fireman's use.

TABLE I.—Showing Different Makes and Sizes of Fire Engines Tested at Boston in 1893.

Name and reference No.		Wt. of eng., lbs.	Diameter of cyl., ins.	Diameter of plgr., ins.	Stroke, ins.	Diam. of boiler, ins.	Heating surf., sq. ft.
Amoskeag	(1)	6,950	6.136	4.005	8.0	31.5	101.0
"	(2)	7,150	6.888	4.249	8.0	30.5	85.0
"	(3)	....	7.602	4.4	7.9	31.75	74.0
"	(4)	7,085	7.651	4.5	7.89	32.0	86.5
Clapp & Jones	(5)	....	6.988	4.376	7.0	29.5	86.0
" " "	(6)	6,475	6.908	4.375	7.0	29.5	86.0
" " "	(7)	6,940	8.5	5.0	7.0	32.0	112.0
" " "	(8)	7,970	9.005	5.49	8.0	35.5	140.5
Silsby	(9)	....	....	....	..	32.5	174.0
"	(10)	7,625	....	....	..	36.0	225.0
"	(11)	....	....	....	..	36.0	229.0

TABLE II.—Showing Coal Consumption, Evaporation, Steam and Water Pressures, Duty and Discharge of Fire Engines Tested at Boston in 1893.

No. of engine.	Time pumps run. h. m. s.	Coal per sq. ft. of grate, per hour. lbs.	Water evap. per lb. coal, from and at 212°. lbs.	Av. steam pressure. lbs.	Av. water pressure. lbs.	Duty, ft.-lbs. per 100 lbs. of coal.	Av. quantity pumped per min. galls.
1	2 54 45	191.0	2.26	90.2	143.2	7,619,800	549
1	2 01 10	184.0	..	92.3	124.0	9,632,700	499
2	2 37 45	191.0	2.66	78.4	123.3	5,900,000	535
3	2 59 55	141.6	3.57	75.7	113.8	5,842,000	482
4	2 30 15	138.4	2.88	71.5	136.4	8,112,900	459
5	1 10 05	163.7	...	102.7	121.2	8,736,300	449
5	2 42 40	103.3	5.87	72.1	119.6	14,028,000	545
6	3 03 55	181.6	3.45	92.7	143.0	9,678,400	536
7	2 31 10	117.3	4.94	68.8	119.2	10,201,600	596
8	2 23 00	172.1	3.51	101.3	112.8	7,758,300	910
9	2 51 10	142.5	4.49	76.5	111.5	7,187,400	482
10	1 48 55	91.1	4.22	59.0	102.1	6,482,100	419
10	0 52 30	151.4	4.10	87.8	126.8	7,993,400	564
11	2 00 30	148.4	3.76	74.7	128.1	7,265,000	572

TABLE III.—Showing Discharge of Fire Engines Tested at Boston in 1893 Under Varying Conditions of Steam and Water Pressures, Size of Nozzles, etc.

Time, mins. secs.	Average steam pressure, lbs.	Average watr. press. at engine, lbs.	Diameter of nozzles, ins.	Total discharge per min., gals.
Amoskeag, No. 1; calculated capacity at 300 revs., 408 gallons.				
74 50	70.0	130.0	1⅛, 1⅛	502
42 35	106.3	128.0	1⅛, 1¼	570
17 30	123.7	136.4	1¼, 1⅛	586
16 00	100.7	204.3	1¼*	491
9 15	103.3	147.1	s, 1½	504
8 20	111.4	244.5	1¼	423
Drafting from tank.				
62 20	90.0	111.4	1⅛, 1⅛	512
28 00	78.5	110.8	1⅛, 1¼	562
15 05	112.0	199.6	1¼	379
9 00	123.6	149.8	s, 1½	575
Amoskeag, No. 2; calculated capacity, 300 revs., 562 gallons.				
89 20	77.5	118.3	1⅛, 1¼	561
18 30	72.6	110.9	1¼*, 1⅛	562
15 40	87.6	163.2	1½*	478
8 50	80.0	127.4	s, 1½	583
8 05	75.3	97.2	s, 1¾	674(a)
7 10	88.3	173.1	1¼	353
Amoskeag, No. 3; calculated capacity, 300 revs., 594 gallons.				
52 00	78.3	104.8	1¼, 1⅛	528(b)
37 10	79.2	108.5	1⅛, 1⅛	512(b)
24 50	82.9	178.4	1¼	326(b)
13 30	78.2	122.2	s, 1½	495
12 00	74.0	92.6	1⅛, 1⅛	466(b)
9 30	67.8	67.4	1⅛, 1⅛	427(b)
7 00	63.5	80.7	s, 1⅛	580(a)
6 15	62.6	107.3	s, 1¼	466(d)
4 30	52.8	109.7	1⅛, 1⅛	506(b)
3 15	69.0	116.4	s, 1½	477
3 00	45.0	80.0	s, 1¾	575(a)
Amoskeag, No. 27; calculated capacity, 300 revs., 619 gallons.				
41 10	78.7	142.7	1¼, 1¼	594
18 00	82.0	128.1	1½*, 1¼	640
17 35	104.7	134.0	1¼, 1¼	596
16 30	97.5	148.4	1⅛, 1¼	587
16 20	75.5	154.7	s, 1½	566
11 50	93.3	147.8	1⅛, 1¼	600
11 20	72.5	147.1	1⅛, 1¼	604
7 20	79.4	131.3	1¼, 1¼	576
Clapp & Jones, No. 5; calculated capacity, 300 revs., 525 gallons.				
57 30	70.8	116.7	1¼, 1⅛	577(b)
48 00	73.2	115.7	1⅛, 1⅛	556(b)
26 50	75.2	122.5	1⅛, 1¼	536
20 10	72.9	133.5	1¼(e), 1⅛	535
Drafting from tank.				
16 00	100.3	116.5	1¼, 1⅛	517
13 50	105.9	112.4	1⅛, 1¼	547
12 40	87.5	87.1(f)	1⅛, 1⅛	435
11 20	98.2	93.1(f)	1⅛, 1⅛	467
3 45	113.3	205.7	1¼	304(g)
Clapp & Jones, No. 6; calculated capacity, 300 revs., 524 gallons.				
48 35	89.4	124.7	1¼, 1¼	575
41 00	90.7	140.2	1⅛, 1⅛	582
24 10	112.0	138.1	1¼, 1⅛	607
11 25	102.3	152.8	s, 1½	576
10 45	82.3	127.0	1⅛, 1¼	573
8 15	114.9	219.5	1¼	472
8 10	107.9	221.4	1¼	407
7 30	118.8	217.5	1¼	479
5 10	42.2	109.1	1¼	277
3 40	44.0	117.4	1¼	294
Clapp & Jones, No. 7; calculated capacity, 300 revs., 691 gallons.				
45 00	85.1	147.0	1¼, 1¼	640(b)
33 40	51.0	98.4	1⅛, 1⅛	504(b)
24 00	65.2	119.6	1¼, 1⅛	581(b)
19 00	70.0	124.2	1⅛, 1⅛	563(b)
12 00	61.4	86.7	s, 2	637(a)
9 00	89.8	123.4	s, 1¾	725(a)
Clapp & Jones, No. 8; calculated capacity, 300 revs., 957 gallons.				
64 10	107.0	130.3	1⅛, 1¼, 1⅛	900
35 35	95.3	96.3	1⅛(h)	978
12 30	95.3	101.4	2 (i)	989
11 50	98.2	96.6	Two 1¼; two 1⅛	1,022
4 50	115.1	173.9	1¼*, 1⅛	749
Silsby, No. 9; calculated capacity, 300 revs., not given.				
50 30	78.9	101.6	1⅛, 1¼	515(b)
37 50	74.5	102.2	1⅛, 1¼	550(b)
14 20	86.6	143.4	1½*	441
12 00	71.2	96.8	1¼, 1¼*	502
11 00	66.1	90.4	1⅛, 1¼*	498
10 00	83.8	151.1	1¼	327
9 20	86.4	158.1	1¼*	395
7 40	80.0	151.6	1¼	387
4 20	66.0	88.7	1¼, 1¼*	527
Silsby, No. 10; calculated capacity, 300 revs., not given.				
37 00	55.2	86.4	1¼, 1⅛	460
27 30	72.8	104.0	1⅛, 1⅛	484
14 30	52.9	124.1	1¼	295
12 25	65.4	157.4	1¼	335
10 00	44.6	82.3	1¼, 1¼	470
43 30	91.4	136.6	1¼, 1¼	590(k)
Silsby, No. 11; calculated capacity, 300 revs., not given.				
41 30	70.7	127.6	1¼, 1¼	611
21 00	79.7	141.1	1¼, 1¼	612
19 30	82.6	124.5	1¼, 1¼*	662
17 20	78.9	120.2	1¼, 1¼	594
5 40	86.7	207.8	1¼	403
4 40	88.4	139.6	1¼, 1¼	582

Note.—* 3-in. hose. (a) 200-ft. hose. (b) 400-ft. hose. (c) 600-ft. hose. (d) one 450-ft., one 550-ft. hose. (e) ring nozzle. (f) air leaking into suction through relief valve. (g) 1,000-ft. hose. (h) four nozzles, each 1¼-ins. (i) four nozzles; one Siamesed, three 2-in. plain; three lines 200 ft., one line 450 ft. 3 ins. (k) second trial. (s) Siamesed nozzles.

* Some at least of the efficiencies shown for this engine are evidently too high to be correct. The figures given for engine No. 8 probably represent more correctly the average efficiency of a steam fire engine in good order.—Ed.

PROPOSALS FOR A NEW WATER SUPPLY FOR JERSEY CITY.

The bids for a new water supply for Jersey City* were opened on March 25, under four distinct specifications. Two companies submitted bids, the East Jersey Water Co., through Mr. Clemens Herschel, M. Am. Soc. C. E., Chief Engineer, of No. 2 Wall St., New York city, and the Jersey City Water Co., through Mr. Sidell Tilghman, President, of 54 Exchange Place, New York city, and Mr. Erie Swenson, Secretary. The latter company was incorporated at Trenton, N. J., on March 23, 1895. No proposals were submitted under Specification D, for filtering the present supply, and some of the propositions of the East Jersey Water Co. were rejected as informal.

The bid of the East Jersey Water Co. was for water pumped to the present Belleville reservoir at an elevation of 157 ft. above mean high tide, and the maintenance for three years, ready for use, of the pumping station which now delivers water to this reservoir. In all the proposals given below it is understood that the city will pay for at least 20,000,000 gallons daily, regardless of the consumption.

The company proposed to pump water from the Passaic River at Little Falls, at a point 158 ft. above the sea, to a storage reservoir at or near Great Notch, about 310 ft. above sea level, from which a steel conduit, or conduits, would lead to the Belleville reservoir. The bids under the four schemes in the specification were as follows:

	Price per Million Gallons.			
	Minimum consumption of 20,000,000 gals.		Minimum delivery of 50,000,000 gals.	
Millions of gallons.	Two supply mains.	One supply main.	Two supply mains.	One supply main.
20	$40.00	$38.50	$55.00	$53.50
20-25	39.00	37.50	53.00	51.50
25-30	37.50	36.00	52.00	50.50
30-35	34.00	33.00	50.00	49.00
35-40	31.00	30.00	48.00	47.00
40-45	26.00	25.00	45.00	44.00
45-50	21.00	20.00	35.00	34.00

With a minimum daily consumption of 20,000,000 gallons, the company would sell the works to cases to hold only for a period between three and five years, after the completion of the works.

The East Jersey Water Co. also offered to furnish a temporary supply within six months from its Newark main for $38.50 per million gallons, delivered at the Belleville reservoir.

The Jersey City Water Co. proposed to deliver an all-gravity supply at the city's high-service reservoir, 210 ft. above mean high tide, the supply to be taken from ponds and reservoirs in or near the Rockaway Valley.

There would be a 6-ft. brick-lined tunnel or tunnels to carry the supply through the Watchung Mountains, and a viaduct over Peckman's Brook, the tunnel and viaduct aggregating about 3½ miles in length, and the east portal of the tunnel being located somewhere in Montclair. The specifications call for storage reservoirs giving 100 days' supply of 50,000,000 gallons daily, and the maintenance for three years' ready for use of the present pumping plant at Belleville.

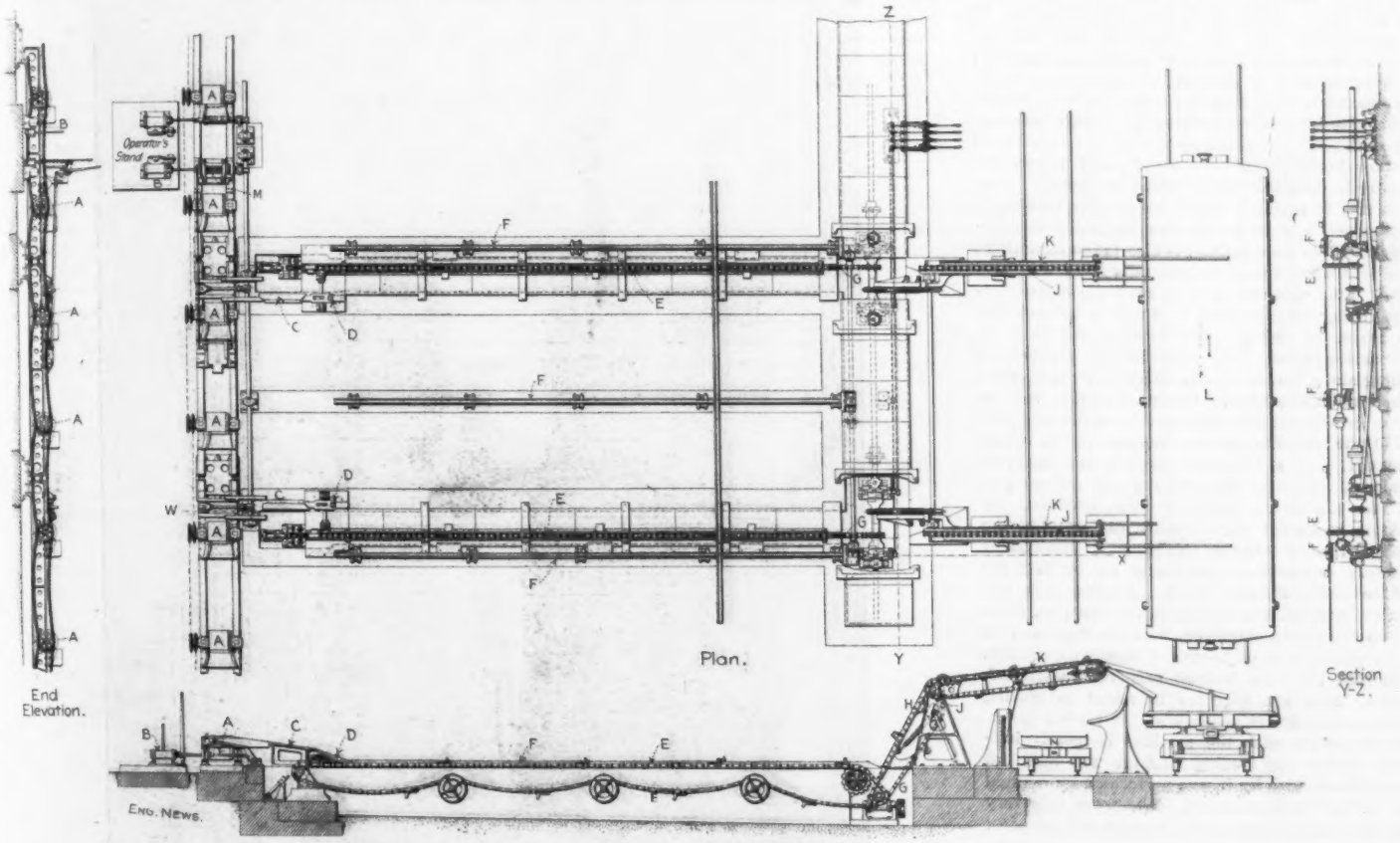
The bids of the Jersey City Water Co. were as follows.

	Price per Million Gallons.			
	Minimum consumption of 20,000,000 gals.		Minimum delivery of 50,000,000 gals.	
Millions of gallons.	Two mains.	One main.	Two mains.	One main.
20	$44.00	$39.75	$50.00	$47.00
20-25	42.00	37.00	48.00	45.00
25-30	40.00	35.00	45.00	42.00
30-35	36.00	32.00	42.00	39.00
35-40	32.00	29.00	39.00	36.00
40-45	28.00	27.00	37.00	33.00
45-50	25.00	25.00	35.00	30.00

Under the first of the above two propositions, the company would sell its plant for $8,000,000 if two supply mains were required, and for $7,000,000 if only one was put in. Under the second scheme, the price would be $9,000,000 and $8,500,000, respectively.

A communication, signed by Mr. H. J. Reilly, contractor, 31 Wall St., a boiler company, a steel-pipe company, and Mr. C. C. Vermuele, Chief Engineer, was received. It stated that they could not bid under the specifications and outlined a joint scheme for a city and company undertaking. A number of requests for postponement of the date for opening bids were sent in.

* See Eng. News, Jan. 24 and 31, Feb. 7 and March 7, 1895.



RAIL LOADING MACHINE, LACKAWANNA IRON & STEEL CO.

RAIL-LOADING MACHINE; LACKAWANNA IRON & STEEL CO.

The rail-loading machine shown in the accompanying cut, and which is in operation at the works of the Lackawanna Iron & Steel Co., at Scranton, Pa., is the invention of Mr. John A. F. Svenson, M. E., of that company, to whom we are indebted for blueprints and information. This important addition to labor-saving machinery for rolling mills, etc., consists essentially of a series of fixed and movable frames, along which the rails are moved by lugs on traveling chains, but it is so constructed that different qualities of rail can be loaded separately at the same time upon different cars, either for direct shipment or for transfer to other parts of the works. On the cut only half of the width of the machine is shown.

From the finishing department of the rolling mill the rails are brought down to the machine by the rollers A, driven by sprocket wheels and chains, and are stopped at the end of one or other half of the machine. From the rollers A the rails are shifted laterally by mechanism operated by the

cylinder B to the incline C, and one rail at a time is released at the bottom by the catch D, operated by the lugs on the chain E, while another lug holds back the rest of the rails until the catch D returns to its former position. The lugs on chain E then move the rail forward along the bars F, at the end of which the rail is picked up by the lugs on the lifting chain G, and carried up the incline H, at the top of which it is engaged by lugs on a third chain, J, which move it along the adjustable delivering bars or arms K, from the ends of which it slides down skids into the railway car L standing on the loading truck. For loading by the other half of the machine the movable stop M is withdrawn, and the rails travel on to the second half of the machine, by which they are loaded in a similar way onto the car N.

The machine illustrated has been in operation for a year at the South Works of the Lackawanna Iron & Steel Co., being used exclusively for loading rails, for which purpose it was built; but similar machines could, of course, be designed for handling other material of the same character. The mill has a capacity of 1,000 tons in 24 hours, but the machine is required to load this output in 12 hours, as it is run only during the day, and experience has shown that very much more material could be handled if necessary. As already noted, the machine has two separate loading tables, placed side by side, so that besides loading the output of the mill for direct shipment, it can be used also for loading the rails upon small trucks for transfer to different points within the works. Very often this is required while the regular loading is in progress, and both cars can be loaded simultaneously. This arrangement is also taken advantage of in separating the first-class rails from the "seconds." One operator, a boy, runs the entire machine, being stationed on a platform beween the two parts, as shown. He watches the rails as they arrive from the rail-finishing department (coming along the rollers A), each rail being marked to indicate its quality. For a first-class rail he throws in the stop M, and sends the rail down that half of the machine which is nearest to the source of supply. If a "second" arives, the operator withdraws the stop M, allowing the rail to proceed to the other half of the machine, by which it is loaded onto another car or onto the transfer trucks. Rails requiring a subsequent treatment are allowed to travel on beyond the machine along the rollers A. Besides this one operator, who belongs strictly to the machine, there are two other men employed, who are stationed on the car which is being loaded with first-class rails, to see that the rails become properly distributed. As these men are required to assist in getting the cars to the exact position at the loading point, their connection with the machine is merely incidental. Before the loading machine was built, all the work now done by it was performed by manual labor, 12 men being required. The work was very laborious, especially with the heavier rail sections, and consequently the men had to be well paid. A considerable saving was therefore effected, and we are informed that the machine is now paying a good interest on the investment. The machine is easy to keep in repair, and does its work admirably.

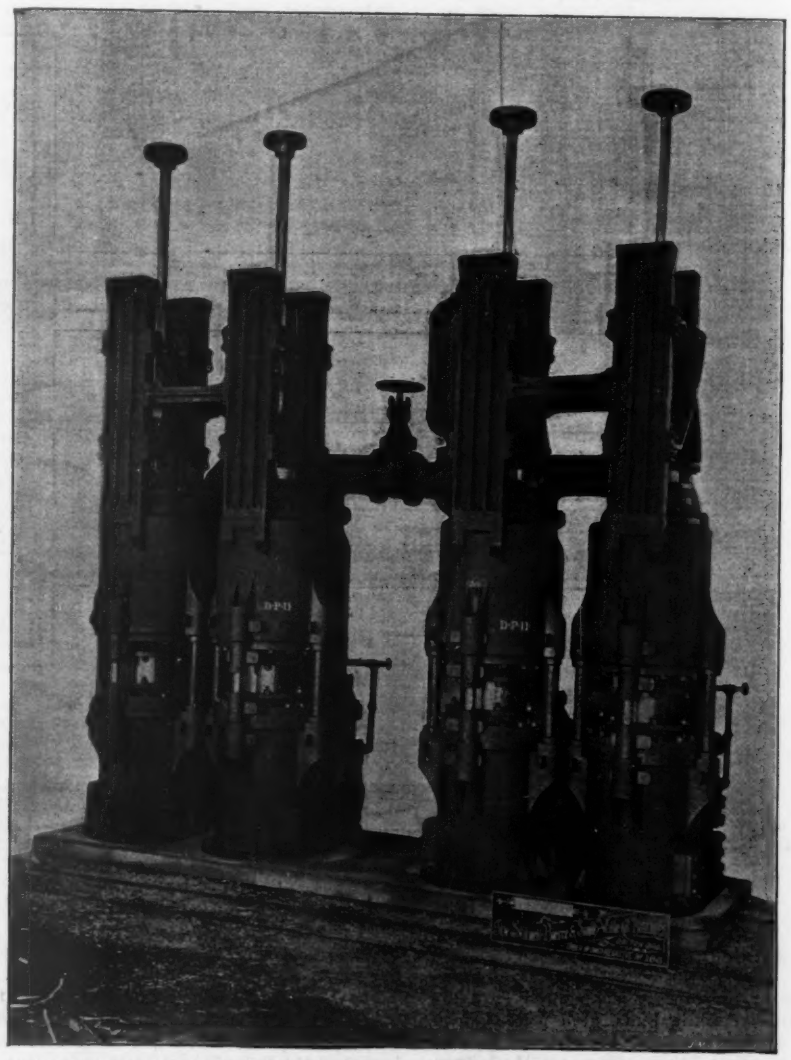
It will be seen that the horizontal part of the machine occupies a large proportion of the space between the roller line and the car, which arrangement was a necessity in this case in order to allow the loaded cars to run past the rail-finishing mill, close to which the machine is built. This, however, has been found to be an advantage rather than an inconvenience, as this part, on one-half of the machine, may, under certain contingencies, be used for storing a large quantity of rails that might otherwise block the finishing department. This may occur where there is an unusual delay in furnishing railway cars, and in such case, while one-half is used for storing the rails, the other half is kept free for loading, and the "seconds" are cared for outside of the machine. In loading the rails thus stored upon the horizontal bed upon the car, clutches on the driving shaft are disengaged, so that the horizontal chains E are not run, while the chains on the incline H and loading arms K are still running, the rails being loaded by hand onto the lifting chain G. The main driving shaft is located in the pit, as shown, and is driven by belting from an overhead countershaft. The first roller of the roller carriers, A, is driven by belting in the finishing department, and the other rollers are driven one from the other by malleable iron chains.

DEEP-WELL PUMPING ENGINES FOR THE NAPOLEON, O., WATER-WORKS.

The accompanying cut represents the water ends of two direct-acting pumping engines of the deep-well type, recently built for the water-works of Napoleon, O. The engines have steam cylinders 10 × 18 and 18 × 18 ins., and water plungers 11¼ × 18 and 14½ × 18 ins. The pumping capacity of each engine is 1,000,000 gallons per 24 hours, and they furnish a domestic pressure of 65 lbs. and a fire pressure of 125 lbs. per sq. in.

The water cylinders shown in the cut are placed at the bottom of the pump pit, 18 ft. below the floor of the engine room. The pump is of the differential plunger pattern, the diameters of the plungers being so proportioned that the work done on the down stroke is greater than that done on the up stroke by the amount due to the weight of the moving parts, thus equalizing the work in the two ends of the steam cylinders. The plungers are outside packed, the packing being adjustable while the engine is working, so that any leakage can be promptly stopped. The water cylinders are connected by turned rods keyed into lugs on the cylinders, as shown, and the water valves have an ample area of opening, and are readily accessible by means of hand holes.

The steam end of each engine consists of a vertical inverted compound condensing engine, of the duplex direct-acting type, resting upon heavy wrought iron I-beams spanning the pump pit. Balanced slide valves are used, and the steam pistons are easily accessible by removing the cylinder heads. Live steam can be turned into the low-pressure cylinders at a moment's notice, so as to give a heavy fire pressure in the mains. The steam and water cylinders are connected by heavy cast iron framing, well braced, and the pump rods pass through guides in this framing, so as to prevent springing. The exhaust steam is condensed in a Wheeler condenser, through which the water from the pumps is passed, and the water of condensation is pumped to the hot well by a crank and flywheel air pump, after which it passes through a Stilwell-closed feed-water heater before being delivered to the boilers. The exhaust steam may be discharged direct into the atmosphere in case of any repairs being required by the condenser. These engines being built by the Stilwell-Bierce & Smith-Vaile Co., of Dayton, O.



WATER CYLINDERS OF THE PUMPING ENGINES FOR THE WATER-WORKS, AT NAPOLEON, O.

A portable sand-blast plant has been built by the Campbell Gas Engine Co., of Halifax, England, for cleaning paint off girders and off the fronts of houses. On an iron-framed truck is mounted an oil engine belted to an air-compressor, which is connected to an air receiver loaded to 15 lbs. pressure. The same apparatus, but without the sand, is used to blow paint onto the cleaned surface.

The total number of immigrants arriving in this country during the year ending June 30, 1894, was 314,467, as compared with 543,667 in 1893 and 644,353 in 1892. The nationality of immigrants in 1894 was as follows:

Germany	59,386
Italy	43,966
Russia (not including Poland)	35,694
Ireland	33,904
England	29,579
Sweden and Norway	27,475
Austria and Bohemia	23,108
Hungary	14,397
Scotland	7,254
Poland	1,552

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PERSONALS.

Mr. S. A. Taylor has been elected Borough Engineer of Turtle Creek, Pa.

Dr. G. Leo Mees has been appointed President of the Rose Polytechnic Institute, at Terre Haute, Ind.

Mr. E. C. O'Brien has been appointed a member of the Dock Commission of New York city, vice Mr. A. J. White.

Capt. William H. Jaques, M. Am. Soc. C. E., has been appointed to the command of the Naval Reserve of New Jersey.

Capt. B. T. Reynolds, of Waldron, Mich., one of the builders of the West Michigan R. R., and inventor of the Reynolds switch, died recently.

Mr. J. W. Schaub, M. Am. Soc. C. E., has accepted the position of Chief Engineer and Manager with the Hamilton Bridge Co., at Hamilton, Ont., to take effect April 15.

Mr. E. Wegmann, Jr., M. Am. Soc. C. E., recently gave a lecture on "The Water Supply of New York" before the students of the Department of Engineering, University of New York.

Messrs. Oscar Lowinson and Herman Jonson have opened an office in the Taylor Building, 39 Cortlandt St., New York City, and will practice as architects and engineers, under the firm name of Lowinson & Jonson.

Mr. W. T. Reed has been appointed Superintendent of Motive Power of the Seaboard Air Line, with offices at Raleigh, N. C., vice Mr. James Maglenn, resigned. Mr. Reed was formerly Superintendent of Motive Power of the Chicago Great Western Ry.

Mr. Henry Thompson and Mr. Frank L. Owens, two American railway contractors who were on their way through Mexico to work on the Guatemala Northern Ry., were attacked by bandits in the state of Chiapas, Mexico. Mr. Thompson was killed and Mr. Owens seriously wounded.

Prof. Peter H. Vander Weyde, who died in New York March 18, at the age of 82, was born in Holland, became Professor of Mathematics and Natural Philosophy at the Government College, and came to this country in 1849. He was Professor of Industrial Science at Girard College, Philadelphia, in 1864, and later became editor of the "Manufacturer and Builder."

Mr. Stevenson Constable, an architect of many years' experience, has been appointed by Mayor Strong Superintendent of Buildings of New York city. Mr. Constable was born in Philadelphia, about 43 years ago, but has practiced his profession in New York for the last 11 years. He is a member of the American Institute of Architects and of the Engineers' Club of Philadelphia.

Mr. A. E. Bachert, of Rockhill Furnace, Pa., has resigned his positions as Resident Engineer and Land Agent for the East Broad Top R. R., and Mining Engineer and Land Agent for the Rockhill Iron & Coal Co., the Broad Top Improvement Co., and the Broad Top Semi-Anthracite Coal Co. The resignation will take effect on April 1, and Mr. Bachert will engage in engineering, contracting and architectural work, with offices at Hazleton, Pa.

Mr. Paul Hill, who died at Lowell, Mass., March 23, at the age of 79, was an engineer on the construction of the Northern Canal in 1846, and for many years was constructing manager of the water-works of the Locks and Canals Company. He was superintendent at Hoosac Tunnel, built the breakwater dike at Cape Cod, and did other extensive engineering work in New England and the West. He was at one time a member of the Metropolitan Sewerage Commission, of Boston.

Mr. William Martin Aiken, M. Inst. A. A., of Cincinnati, O., has been appointed Supervising Architect of the U. S. Treasury Department, to succeed Jeremiah O'Rourke, resigned. Mr. Aiken was born in South Carolina about 42 years ago, and studied architecture abroad and under Richardson. He has been practicing his profession in Cincinnati for the last 10 or 15 years, and is said to have designed and erected a number of the finest private residences of that city. He also designed and built the Brice Scientific Hall of the Miami University, at Oxford, O.

Henry Coppee, LL. D., acting President of Lehigh University, died on March 21 at Bethlehem, Pa., of heart disease. Mr. Coppee was born in Georgia 74 years ago; was graduated from Yale in the class of 1839, and from West Point in 1845. He was breveted Captain in the 1st Artillery on Aug. 20, 1847, for gallant and meritorious conduct at the battles of Contreras and Churubusco, in Mexico. He was principal Assistant Professor of Geography, History and Ethics at the Military Academy at West Point in 1850-55. From 1855 to 1866 he was Professor of English Literature and History at the University of Pennsylvania. In the latter year he became President of the Lehigh University, and so continued until 1875, when he resigned the presidency, but continued as Professor of English Literature and History. He has been acting President since the death of Dr. Lamberton. Mr. Coppee had been a Regent of the Smithsonian Institute since 1874, and was the author of a number of works on logic, rhetoric, English literature and poetry.

Mr. Edward P. North, M. Am. Soc. C. E., has been made Water Purveyor of the city of New York. Mr. North was graduated from Union College in 1856, was a student under Col. Wm. M. Gillespie, and commenced professional work in civil engineering under the late Mr. E. S. Chesbrough on the sewerage of Chicago. After remaining with Mr. Chesbrough for four years he was engaged on various railways, and was later engineer in charge of work for the Union Pacific Ry. in Weber Canon. Mr. North had considerable to do with rock excavation under water and was the first engineer in the East to use nitro-glycerine in this work, industrially, on the New Canaan Railway in 1868. He was for a considerable time engaged under the government engineers on the Upper Mississippi River and the harbors of Lakes Superior and Michigan. He was later engineer in charge of roads and streets in the Annexed District in New York; was in charge of railway work in Durango, Mexico, and as an expert engineer was called upon to investigate and report upon various water supplies and irrigation schemes. Mr. North is one of the oldest members of the American Society of Civil Engineers, having been elected on Dec. 4, 1867; he was a director of the society in 1891, and has contributed a number of valuable papers to the Transactions, especially upon the subject of roadway construction. He twice went to Europe to study pavements and roads, and he has been awarded the Norman medal of the society for a paper upon this subject.

ENGINEERING SOCIETIES

COMING TECHNICAL MEETINGS.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
April 1. Secy., C. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
April 1. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
COLUMBIAN ENGINEERING SOCIETY.
April 2. Secy., W. F. Hart, University Building, 15th and H. Sts. N. W., Washington, D. C.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
April 3. "Specifications for Structural Steel," by H. H. Campbell. Secy., C. W. Hunt, 127 E. 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
April 3. "Methods of Determining the Heating Power of Coals," by J. H. Kinealy. Secy., W. H. Bryan, Turner Block.
WESTERN SOCIETY OF ENGINEERS.
April 3. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
April 5. Secy., O. H. Von Gelden, 819 Market St., San Francisco.
FRANKLIN INSTITUTE, PHILADELPHIA.
April 5. "The Camera in the Wake of Flood, Cyclone and Thunderstorm," by W. N. Jennings. Secy., W. H. Wahl.
ENGINEERS' CLUB OF PHILADELPHIA.
April 6. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERING CLUB OF COLUMBUS, O.
April 6. Secy., David Buell.
ENGINEERS' CLUB OF KANSAS CITY.
April 8. Secy., F. W. Tuttle, Baird Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
April 9. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
April 9. Secy., F. A. Coburn, Case Library Building.
NORTHWESTERN RAILWAY CLUB.
April 9. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
WISCONSIN POLYTECHNIC SOCIETY.
April 9. Secy., W. K. Means, Loan & Trust Building, Milwaukee.
DENVER SOCIETY OF CIVIL ENGINEERS.
April 9. Secy., H. Breen, 36 Jacobson, Block.
NEW ENGLAND RAILROAD CLUB.
April 10. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
April 11. Secy., Jas. K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
April 11. Secy., H. D. Ruhm, Nashville, Tenn.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
April 11. Secy., C. H. McLeod, 12 Mansfield St., Montreal.
MONTANA SOCIETY OF CIVIL ENGINEERS.
April 13. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
INDIANAPOLIS ENGINEERING CLUB.
April 13. "Wind Pressure," by Mr. Thomas H. Perry. Secy., C. C. Brown, City Engineer.
ENGINEERS' CLUB OF MINNEAPOLIS.
April 15. Secy., E. Nelson, Kasota Block.
WESTERN RAILWAY CLUB.
April 16. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
April 17. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
April 17. Secy., F. Van Vleck, Los Angeles, Cal.
BOSTON SOCIETY OF CIVIL ENGINEERS.
April 17. Secy., S. E. Tinkham, City Hall, Rooms 36 Bromfield St.
NEW YORK RAILROAD CLUB.
April 18. Secy., John A. Hill, 256 Broadway, N. Y. City.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
April 18. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
April 18. Secy., J. F. Wilson, Odd Fellows' Temple.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 18. Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.
CENTRAL RAILWAY CLUB.
April 24. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 14. Secy., D. W. Meeker, St. Paul, Minn.

BOSTON SOCIETY OF CIVIL ENGINEERS.—The annual meeting was held at the society's quarters on Wednesday evening, March 20. In the afternoon of the same day a number of the members visited the garbage disposal works of the New England Construction Co., in the Dorchester section of the city, where a portion of the garbage of Boston is treated by a utilization process. The plant was in operation at the time of the visit, and is described and illustrated in detail elsewhere in this issue. Mr. F. I. Winslow, Chairman of the Excursion Committee of the society, had charge of the trip, while Mr. John H. Soley and Mr. W. C. Merrill were at the plant to represent the company. This was the seventh excursion of the society during the year, and one more will be held before the official year closes. On returning from the trip a number of the members of the society took supper together at the Quincy House, a pleasant feature in the life of the society prior to each of the regular meetings. The meeting was opened by Mr. W. E. McClintock, M. Am. Soc. C. E., President of the society during the year just closing. The report of the various officers brought out the following facts:

During the year ten regular meetings were held, with an average attendance of 90, and an annual dinner at which 163 were present. The net gain in the membership of the society during the year was 32, making a total of 354 members, of which two are associate, four honorary, and the balance active. The society is now entitled to a fourth member on the Board of the Association of Engineering Societies. The society now has a permanent fund of about $6,000, saved, it appears, from its ordinary revenues. Recently Mr. Desmond FitzGerald, M. Am. Soc. C. E., has given $50 as the beginning of a building fund. A Committee on Permanent Quarters is in existence, and it is hoped that a suitable home may soon be found, as the present library and reading room are very much crowded. Memoirs were read on the late L. C. Heywood, late Engineer of the Town of Lincoln, R. I., and on Hiram Nevons, who was for many years and at the time of his death Superintendent of the Cambridge water-works. The following officers were elected for the ensuing year: President, A. F. Noyes; Vice-President, Dexter Brackett; Secretary, S. E. Tinkham; Treasurer, E. W. Howe; Librarian, F. L. Locke; Director for two years, R. A. Hale; all but Mr. Locke are members of the American Society of Civil Engineers. After the election Mr. McClintock made some general remarks in relation to engineers and engineering societies, in the course of which he stated that honesty is the first requisite for an engineer, and that his judgment ought not to be open for sale to the highest bidder; also that a local engineering society should be the home and school of young engineers. Mr. McClintock then showed some lantern views of Massachusetts roads before and after the beginning of work by the State Highway Commission, of which he is a member. The law under which the commission acts provides that the contracts for work in each town must be let to the selectmen of the towns, if they so desire. The commission has succeeded, although with much difficulty, in getting the selectmen to do all work thus far undertaken, amounting to 27 contracts. In nearly every town where work has been completed the selectmen have made a profit for the town on the contracts ranging from $15 to $1,500, besides paying fair prices for the local labor and material employed. In every case where a profit has been thus made, the towns have voted to use it for more good roads. The whole procedure outlined above shows the localities concerned not only what good country roads are, but how to make them; how to enter into and execute contracts; and the value of engineering advice and supervision.

Mr. McClintock favors laying telford in a bed of gravel, instead of on the natural earth, when that is of other material.

Views were also shown of roads and other scenery in Bermuda, which place Mr. McClintock recently visited. Many deep vertical rock cuts were shown, executed to reduce all road grades to 10% or less. The

rock is of coral formation, easily cut, and used almost exclusively for buildings on the island, even to roof coverings, which are of slabs fastened to cedar rafters.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the regular monthly meeting on March 14, it was voted to hold meetings on the second and fourth Thursdays of each month, instead of the second Thursday only, as formerly. A paper by Prof. Schuermann on "A Method of Determining the Probable Traffic of a New Road," was read, applying to the local roads of Tennessee and Kentucky, and the subject of "The Preservation of Iron Surfaces" was discussed. Herman D. Ruhm, Secy.

INDIANAPOLIS ENGINEERING CLUB.—At the meeting on March 23 Mr. Edward Hill described some special constructions in sewers made last year in Indianapolis, showing the method of making an overflow into Pogue's Run for storm water, and permitting the sewage to go under the Run into the intercepting sewer; the method of making an ordinary junction of a large sewer with a smaller one, and the method of getting across eight railway tracks, using a Lidgerwood machine, without delaying traffic or work unnecessarily. He also showed the method of connecting the old 8-ft. sewer with the new 8-ft. sewer, so as to use the lower end of the old sewer as an overflow for storm water and divert the sewage into the new sewer to be carried to the intercepter and below the city; steel I-beams, with brick jack arches between, were used here instead of a large arch spanning the entire junction, which in this case would have been of about 22 ft. span. The next meeting will be held April 13, when the subject of "Wind Pressure" will be discussed, Mr. Thos. H. Perry being the leader of the discussion. Chas. C. Brown, Secy.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on March 20, the committee on Standard Gages for Sheet Metals presented its report favoring that proposition to make metal gages vary by even thousandths of an inch. Prof. W. S. Chapin, Chancellor of Washington University, delivered an address on German engineering schools. An abstract is given in another column. W. H. Bryan, Secy.

TECHNICAL SOCIETY OF THE PACIFIC COAST.—This society has applied for membership in the Association of Engineering Societies, making the twelfth member of that association.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Mar. 29.	Bridge bonds,	Winnipeg, Man.	Feb. 21
Mar. 29.	Elevators for pub. bldg.,	New York.	Mar. 7
Mar. 29.	Curbing, etc.,	Richmond, Ind.	Mar. 14
Mar. 29.	Pipe sewers (3 miles),	Roselle, N. J.	Mar. 14
	Advertised, Eng. News, Mar. 14 and 21.		
Mar. 29.	Electric wiring, etc.,	Philadelphia, Pa.	Mar. 14
Mar. 29.	Paving 27 alleys,	St. Louis, Mo.	Mar. 21
Mar. 29.	Fire engines, etc.,	Baltimore, Md.	Mar. 21
Mar. 29.	Self-prop. autom. dump. boat,	N. Y.	Mar.
Mar. 29.	Boiler work, etc.,	Newark, N. J.	Mar. 28
Mar. 30.	Water-works system,	Pawling, N. Y.	Feb. 28
	Advertised, Eng. News, Feb. 28 to Mar. 21.		
Mar. 30.	Pipe sewers (14,772 ft.),	Marion, O.	Mar. 7
Mar. 30.	Wharfwork at Blackbeard Island,	Ga.	Mar. 14
Mar. 30.	Building shops,	Pittsburg, Pa.	Mar. 14
Mar. 30.	Sidewalks,	Houston, Tex.	Mar. 14
Mar. 30.	Sewer,	Sandusky, O.	Mar. 14
Mar. 30.	Pipe sewer,	Davenport, Ia.	Mar. 21
Mar. 30.	Manhole frames (360),	Medford, Mass.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Mar. 30.	Pipe sewers (20,477 ft.),	Medford, Mass.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Mar. 30.	Dikes, Canning,	N. S.	Mar. 28
Mar. 30.	Repairing 36 streets,	Pittsburg, Pa.	Mar. 28
Mar. 30.	Garbage disposal,	Detroit, Mich.	Mar. 28
Apr. 1.	Brick paving (20,000 yds.),	Newark, O.	Feb. 21
Apr. 1.	Sewer,	Keokuk, Ia.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
Apr. 1.	Water bonds,	Bancroft, Ia.	Feb. 28
Apr. 1.	Tunnel sewer,	Keokuk, Ia.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
Apr. 1.	License to cut timber,	Toronto, Ont.	Mar. 7
Apr. 1.	Granite block pav'g,	Cincinnati, O.	Mar. 7
Apr. 1.	Water-wks. supplies,	Oil City, Pa.	Mar. 7
Apr. 1.	Revetment work,	Duluth, Minn.	Mar. 7
Apr. 1.	Steel forgings,	Washington, D. C.	Mar. 14
Apr. 1.	Barracks,	Omaha, Neb.	Mar. 14
Apr. 1.	Main sewer,	Jefferson City, Mo.	Mar. 14
	Advertised, Eng. News, Mar. 14.		
Apr. 1.	Macadamizing, etc.,	Paterson, N. J.	Mar. 21
Apr. 1.	Electric lighting,	Chester, Pa.	Mar. 14
Apr. 1.	Iron bridge,	Gloversville, N. Y.	Mar. 21
Apr. 1.	Laying 20-in. pipe,	Medford, Mass.	Mar. 21
	Advertised, Eng. News, Mar. 21.		
Apr. 1.	30-in. wrought steel pipe,	Cleveland, O.	Mar. 21
Apr. 1.	Chemical engine,	Toronto, Ont.	Mar. 28
Apr. 1.	Pile bridges,	Denver, Colo.	Mar. 28
Apr. 1.	Stone paving,	Albany, N. Y.	Mar. 28
Apr. 1.	Railway (6 miles),	Broadalbin, N. Y.	Mar. 28
Apr. 1.	Railway (25 m.),	Southern Pacific Co.	Mar. 28
Apr. 1.	Cement sidewalks,	Atlanta, Ga.	Mar. 28
Apr. 1.	Brick paving,	La Grange, Ill.	Mar. 28
Apr. 2.	Dredging,	Boston, Mass.	Feb. 28
	Advertised Eng. News, Feb. 28 to Mar. 21.		
Apr. 2.	Brick paving,	Waukegan, Ill.	Mar. 14
	Advertised, Eng. News., Mar. 14 and 21.		
Apr. 2.	Stone curbing,	Peoria, Ill.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Apr. 2.	Artesian well,	Canton, Ill.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Apr. 2.	Life saving station,	Washington, D. C.	Mar. 21
Apr. 2.	Piers,	Philadelphia, Pa.	Mar. 21
Apr. 2.	Steel wire and manila,	Boston navy yd.	Mar. 21
Apr. 2.	Artificial stone walks,	Winton Pl., O.	Mar. 21
Apr. 2.	Stone paving,	Brooklyn, N. Y.	Mar. 21
Apr. 2.	Brick paving,	Trenton, N. J.	Mar. 21
Apr. 2.	Bridge superstructure,	St. Paul, Minn.	Mar. 28
Apr. 2.	Stone, cement, etc.,	Norfolk navy yd.	Mar. 28
Apr. 2.	Cement sidewalks,	Irvington, Ind.	Mar. 28
Apr. 2.	Paving repairs,	St. Paul, Minn.	Mar. 28
Apr. 2.	Bridge,	Indianapolis, Ind.	Mar. 28
Apr. 3.	Brick paving,	Elkhart, Ind.	Mar. 21
Apr. 3.	Brick paving,	Davenport, Ia.	Mar. 21
Apr. 3.	Bridge,	Chillicothe, Mo.	Mar. 28
Apr. 3.	Grading,	Des Moines, Ia.	Mar. 28
Apr. 3.	Grade crossing work,	Buffalo, N. Y.	Mar. 28
Apr. 3.	Pig lead,	Baltimore, Md.	Mar. 28
Apr. 3.	Pipe Sewers,	Meadville, Pa.	Mar. 28
Apr. 4.	Water bonds,	Norwood, O.	Mar. 7
Apr. 4.	B'kwater w'k, etc.,	G'nd Rapids, Mich.	Mar. 14
Apr. 4.	Constructing bdg,	Plattsburg, N. Y.	Mar. 14
Apr. 4.	Brick paving,	Peoria, Ill.	Mar. 14
	Advertised, Eng. News, Mar. 14 to 28.		
Apr. 4.	Dredging,	Newark, N. J.	Mar. 28
Apr. 4.	Lease of water-wks.,	Madison, Ind.	Mar. 28
Apr. 4.	Paving,	Buffalo, N. Y.	Mar. 28
Apr. 5.	Pipe sewers,	St. Louis, Mo.	Mar. 21
Apr. 5.	Brick sewers,	St. Louis, Mo.	Mar. 21
Apr. 5.	Brick paving,	Averyville, Ill.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Apr. 5.	School buildings (5),	St. Louis, Mo.	Mar. 21
Apr. 5.	Water bonds,	Forestville, N. Y.	Mar. 21
Apr. 5.	Pumping machinery,	Knoxville, Ill.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Apr. 5.	Street improvements,	Wooster, O.	Mar. 21
Apr. 5.	Dredging,	Wilmington, Del.	Mar. 14
	Advertised, Eng. News, Mar. 14 to Apr. 4.		
Apr. 5.	Electric light plant at	Milwaukee, Wis.	Feb. 28
Apr. 5.	Heat'g & vent'g app't's,	St Louis.	Mar. 7
Apr. 5.	Grading, etc.,	Washington, D. C.	Mar. 28
	Advertised, Eng. News, Mar. 28.		
Apr. 5.	Electrical conductors,	New York.	Mar. 28
Apr. 6.	Paving,	Newark, O.	Mar. 21
Apr. 6.	River improvements,	Savannah, Ga.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Apr. 6.	Sewers,	Plattsburg, N. Y.	Mar. 21
Apr. 6.	Jetty,	Portland, Ore.	Mar. 21
Apr. 6.	Electric light fixtures,	Milwaukee, Wis.	Mar. 21
Apr. 6.	Laying water pipe,	Evanston, O.	Mar. 28
Apr. 6.	Suction pipe,	League Island navy yard.	Mar. 28
Apr. 6.	Water-works system,	Meadville, Pa.	Mar. 28
Apr. 8.	Bridge bonds ($200,000),	Portland, Ore.	Mar. 14
Apr. 8.	Jail,	Williamson, W. Va.	Mar. 14
Apr. 8.	Dredging,	New York, N. Y.	Mar. 21
	Advertised, Eng. News, Mar. 21 to Apr. 4.		
Apr. 8.	Highways (7 miles),	Houston, Tex.	Mar. 21
Apr. 8.	Water bonds ($15,000),	Coleman, Tex.	Mar. 21
Apr. 8.	Electric lighting,	Chatham, N. Y.	Mar. 28
Apr. 8.	Stone paving,	Jersey City, N. J.	Mar. 28
Apr. 8.	Brick sewers (1,570 ft.),	Lafayette, Ind.	Mar. 28
Apr. 8.	Electrical installation,	Pittsburg, Pa.	Mar. 28
Apr. 8.	Sewers,	Louisville, Ky.	Mar. 28
Apr. 9.	Water-wks. system,	Seneca, Kan.	Mar. 7
	Advertised, Eng. News, Mar. 7.		
Apr. 9.	Sewers,	Westfield, N. J.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Apr. 9.	Sewers,	Indianapolis, Ind.	Mar. 28
Apr. 9.	Bridges,	Indianapolis, Ind.	Mar. 28
Apr. 9.	Macadamizing,	St. Louis, Mo.	Mar. 28
Apr. 10.	Buildings at Fort Meyer,	Va.	Mar. 14
Apr. 10.	Water bonds ($60,000),	Westville, N. S.	Mar. 21
Apr. 10.	Water-works system,	Celina, O.	Mar. 21
	Advertised, Eng. News, Mar. 21 and 28.		
Apr. 10.	Sewers,	Cincinnati, O.	Mar. 21
Apr. 10.	Dam,	Nashua, N. H.	Mar. 21
	Advertised, Eng. News, Mar. 21.		
Apr. 10.	Iron gratings,	Mansfield, O.	Mar. 21
Apr. 10.	Water-wks. system,	Lyndonville, Vt.	Mar. 28
	Advertised, Eng. News, Mar. 28.		
Apr. 10.	School building,	Elizabeth, N. J.	Mar. 28
Apr. 11.	Sewers,	Peoria, Ill.	Mar. 21
	Advertised, Eng. News, Mar. 21 to Apr. 4.		
Apr. 11.	Composite light vessel,	Wash'ton, D. C.	Mar. 21
Apr. 11.	Sewer pipe, etc.,	West Newton, Mass.	Mar. 28
	Advertised, Eng. News, Mar. 28 and Apr. 4.		
Apr. 11.	Street sweeping machine,	Easton, Pa.	Mar. 28
Apr. 11.	Water-wks. system,	Maywood, Ill.	Mar. 28
	Advertised, Eng. News, Mar. 28.		
Apr. 11.	Cast iron pipe,	Brooklyn, N. Y.	Mar. 28
	Advertised, Eng. News, Mar. 28 and Apr. 4.		
Apr. 12.	Breakwater,	Davids Island, N. Y. H.	Mar. 21
Apr. 12.	Brick paving,	Springfield, O.	Mar. 21
Apr. 12.	Steel bridge (220 ft.),	Ogdensburg, N.Y.	Mar. 28
	Advertised, Eng. News, Mar. 28.		
Apr. 12.	Brick jail,	King George, Va.	Mar. 28
Apr. 12.	Public building at	Salina, Kan.	Mar. 28
Apr. 13.	Road improvement bonds,	Athens, O.	Mar. 21
Apr. 13.	Electric lighting,	Stratford, Ont.	Mar. 28
Apr. 15.	Sewer bonds	South Orange, N. J.	Mar. 14
May 15.	Plans, etc., for bridge,	Montreal	Jan. 24
	Advertised, Eng. News, Jan. 24 and 31.		
Apr. 15.	Water-works system,	Westville, N. S.	Mar. 21
Apr. 15.	Dams & shore protec.,	Rock Isl., Ill.	Mar. 21
	Advertised, Eng. News, Mar. 21 to Apr. 11.		
Apr. 15.	Paving dikes,	New York, N. Y.	Mar. 21
Apr. 15.	Water power plant,	West Troy, N. Y.	Mar. 21
Apr. 15.	Dredging, Portland,	Me.	Mar. 21
	Advertised, Eng. News, Mar. 21 to Apr. 11.		
Apr. 15.	Iron towers,	Detroit, Mich.	Mar. 28
	Advertised, Eng. News, Mar. 28 and Apr. 4.		
Apr. 15.	Pipe sewers,	Waukegan, Ill.	Mar. 28
Apr. 15.	Filling, etc.,	San Francisco, Cal.	Mar. 28
Apr. 16.	Stone dikes,	Cincinnati, O.	Mar. 21
	Advertised, Eng. News, Mar. 21 to Apr. 11.		
Apr. 16.	Viaduct substructure,	Cincinnati, O.	Mar. 28
	Advertised, Eng. News, Mar. 28 and Apr. 4.		
Apr. 16.	Viaduct superstructure,	Cincinnati, O.	Mar. 28
	Advertised, Eng. News, Mar. 28 and Apr. 4.		
Apr. 16.	Bridges,	Auburn, Ind.	Mar. 28
Apr. 17.	Sewers (27 miles),	Champaign, Ill.	Mar. 14
	Advertised, Eng News, Mar. 7 to Apr. 5.		
Apr. 17.	Dredging,	Cleveland, O.	Mar. 28
Apr. 17.	Electric light plant,	Willoughby, O.	Mar. 28
Apr. 18.	License to cut timber,	Toronto, Ont.	Mar. 21
Apr. 18.	Paving,	Warren, O.	Mar. 28
Apr. 18.	Stone paving,	Cincinnati, O.	Mar. 28
Apr. 18.	Water-works system,	Digby, N. S.	Mar. 28
Apr. 22.	Elec. light bonds ($12,000),	Elberton, Ga.	Mar. 28
Apr. 24.	Buildings,	San Marcos, Tex.	Mar. 28
	Advertised, Eng. News, Mar. 28 to Apr. 11.		
Apr. 25.	Water-works,	West Troy, N. Y.	Mar. 28
Apr. 30.	Jail,	Dawson, Ga.	Mar. 28
May 1.	Sewer system,	Sudbury, Ont.	Mar. 28
May 1.	Water-works system,	Sudbury, Ont.	Mar. 28
May 1.	Buildings, New Orleans,	La.	Mar. 28
	Advertised, Eng. News, Mar. 28 to Apr. 18.		
May 1.	Metalwork, New Orleans,	La.	Mar. 28
	Advertised, Eng. News, Mar. 28 to Apr. 18.		
May 20.	Water bonds,	Santa Clara, Cal.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 28.		
May 23.	Water-wks. system,	Santa Clara, Cal.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 28.		
No date.	Pipe sewers,	New Rochelle, N. Y.	Mar. 28
"	Power house,	Salt Lake City, Utah.	Mar. 28
"	Sewers,	Fort Shaw, Mont.	Mar. 28
"	Opera house,	Charleston, S. C.	Mar. 28
"	Water-wks. system at	Ft Shaw, Mont.	Mar. 28
"	Elec. light franchise,	Bardstown, Ky.	Mar. 28

RAILWAYS.

East of Chicago.

BURLINGTON & HINESBURG.—We are informed that location surveys have been made and most of the right of way secured for this projected railway between Burlington and Hinesburg, Vt., 13 miles. The company will furnish all material, but has not decided whether all the labor will be contracted; probably part of it will be. It is expected that the construction will be commenced as soon as the weather will permit. Ch. Engr., Frank O. Sinclair, Burlington, Vt.; Pres., Wm. G. Dacey, 40 Wall St., New York.

CENTRAL NEW YORK & WESTERN.—It is reported that this railway is to be extended this summer and the narrow gage division rebuilt.

CINCINNATI, HAMILTON & DAYTON.—Press reports from Dayton, O., state that engineers have commenced to survey a line for the extension of this road to Franklin, O. Two routes will be surveyed—one northeast along the west side of the C., C., C. & St. L., to the Narrows, where it will cross the canal, thence to Franklin mill at the south end of Franklin. At this point it will meet the tracks of the Cincinnati, Jeffersonville & Madison. The other route will, after crossing Second St., in Middletown, run due north through the Stoutenborough addition and Lakeside, thence across the Miami River to Poust Town to the main line of the Cincinnati, Hamilton & Dayton. The work of removing the buildings on the right of way through Middletown was commenced last week. This new route is to be used principally for passenger traffic. Ch. Engr., C. Woods, Cincinnati.

GLOVERSVILLE & BROADALBIN.—We are informed that it was officially decided March 22 to build this railway, which has been located and most of the right of way secured, from Broadalbin to a connection with the Fonda, Johnstown & Gloversville road, four miles north of Gloversville, N. Y. About six miles of new road will be required, and the contracts are to be awarded April 1. It is stated that there will be no bridges, and only two trestles, one 400 ft. and the other 200 ft. in length; there will be one cut about 100 ft. long. J. M. Wolf, of Wolf & Dino, who have been at work on the Fort Plain & Richfield Springs road, have made a proposition to build the line. Ch. Engr., J. W. Cleveland, Broadalbin, N. Y.; Pres., James Shanahan, Gloversville, N. Y.

HARDWICK & WOODBURY.—It is expected that surveys will be made for this short railway between Hardwick and Woodbury, Vt., about 4½ miles, so that contracts can be awarded about May 1. The construction will be sidecutting the entire distance, and will not include any bridges. Pres., G. M. Powers, Morrisville, Vt.; Gen. Man., E. H. Blossom, St. Johnsbury, Vt.

MEDIX RUN.—J. W. Hartman, Medix Run, Pa., writes us that seven miles of this road is in operation, and it is not expected that contracts will be awarded for extending the line until next winter. The road is projected from Medix Run to Clearfield, Pa., 24 miles. Ch. Engr., A. H. Shafer, Emporium, Pa.; Pres., A. M. Dodge, 26 Cortlandt St., New York.

NEW YORK & MISSOURI RIVER.—This company was incorporated last week, with headquarters in New York, to promote the building of railways; capital stock, $1,000; directors, Thos. W. Osborn, Dwight L. Hubbard and John Ford, of New York city.

NEW YORK, NEW HAVEN & HARTFORD.—This company put about 200 men at work last week, according to reports, to drain and fill in 70 acres of land recently purchased by the company at West Chester, N. Y., for an extra freight yard. Several miles of tracks, with switches, are to be laid, the whole to be completed by June.

OLEAN, OSWAYO & EASTERN.—Press reports state that this railway will probably be extended soon from Genesee Forks to Hornellsville, N. Y., and that the right of way is now being secured. Pres., J. B. Rumsey, Oswayo, Pa.

QUINCY QUARRY CO.—We are informed by the Quincy Quarry Co., Quincy, Mass., that a rough survey has been made for a railway about 1¾ miles in length, to connect the quarries with the New York, New Haven & Hartford road. The railway will not carry general freight. It was expected that subscriptions would be received this week for the construction of the road. No contracts have yet been awarded. Ch. Engr., H. L. Whitman; Pres., Thos. McDonell, both of Quincy, Mass.

RUMFORD FALLS AND RANGELEY LAKES.—R. B. Stratton, Ch. Engr., Rumford Falls, Me., writes us that Ward Bros., of Kennebunk, Me., who have the contract for building the first 18 miles of this railway, have the grading nearly finished and will begin tracklaying about May 1. Preliminary surveys have been made for the next 10 miles of the road, and the contracts for this work will probably be awarded in June. Pres., G. C. Moses, Bath, Me.

SINEPUXENT BEACH CO.—Bids will soon be received by this company for building about five miles of narrow gage railway on Baltimore Ave., at Ocean City, Md., the line to be in operation by June 15. J. F. Waggaman, R. G. Keene and Chas. Goldsborough, Equitable Bldg., Baltimore, Md., have charge of the work.

TOLEDO SOUTHEASTERN.—Incorporated in Ohio March 25 to build a railway between Clay Center and Curtice, all in Ottawa county, O.; capital stock, $5,000; principal place of business, Toledo, O.; incorporators, F. H. Dodge, H. P. Dodge, A. C. Johnson, H. T. Yarryon and David M. Arndt.

WEST VIRGINIA CENTRAL & PITTSBURG.—C. M. Hendley, Secy. and Treas. Baltimore & Cumberland Ry. Co., writes us as follows in regard to the proposed line between Cumberland and Hagerstown: No contracts for any portion of the proposed line

from Cumberland to Hagerstown have been made, nor is the matter at present under advisement. The announcements to the contrary in the daily press are unauthorized. While the company intends to construct this portion of its line at the earliest practicable time, the plans necessary to the beginning of the work are as yet undetermined.

Southern.

ERWIN & EMBREVILLE.—A press report from Bristol, Tenn., states that the English representative of the Rothschilds, who bought the Embreville furnace property, with a large tract of land in Washington county, Tenn., is now preparing to build a railway five miles in length between Erwin and Embreville. This will give the furnace an outlet other than by way of the Southern railway. The new route, as reported, will be through Erwin and over the three C's to Johnson City, and thence over the Bristol, Elizabethton & North Carolina to Bristol, making connection with the Norfolk & Western road. The East Tennessee & Western North Carolina narrow gage, which runs from Johnson City to the iron mines at Embreville, N. C., a distance of 93 miles, is to have a third rail put down. The Rothschilds are said to have an agent here with full power to act. The five miles of road will cost about $50,000.

LOUISVILLE & NASHVILLE.—This company is reported as preparing to lessen the grades on its system, and especially on the division of the main line between Louisville and Bowling Green, Ky. A train of 25 cars of pig iron, averaging 48,000 lbs. per car, has been sent out over the line and will attempt to ascend every grade. The number of cars possible on the heaviest grades will be ascertained and the heaviest grades will be reduced during the coming summer to the capacity of the test train.

MURFREESBORO & WOODBURY.—J. E. Thompson, Murfreesboro, Tenn., writes us that the money has been secured to build the proposed railway between Murfreesboro and Woodbury, 20 miles, but that no contracts have yet been awarded.

PLANT SYSTEM.—It is announced in the "Manufacturers' Record" that the Plant system has purchased the Sanford & St. Petersburg road, 153 miles in length, and will change it to standard gage; also that it will change the Palatka & Brooksville division of the Florida Southern, 145 miles in length, to standard gage. The first-named road gives it two lines to Tampa Bay. Pres., H. B. Plant, 12 West 23d St., New York.

SUGAR CREEK, PACK'S BRANCH & PAINT CREEK.—The incorporation of this company was noted in our issues of Nov. 21 and Jan. 24. E. Smith, Gen. Man., Alderson, W. Va., writes us that surveys have been made for this road, which is projected from Mount Hope to the mouth of Paint Creek, 35 miles. A part of the right of way has been secured, and nearly all of the capital subscribed. No contracts have been awarded. Ch. Engr., F. C. Beardsley, Macdonald, W. Va.; Pres., F. N. Smith, Mount Hope, W. Va.

VIRGINIA, FREDERICKSBURG & WESTERN.—We are informed that surveys have been made and all pay rolls and obligations of the company have been promptly met. The road is projected from Fredericksburg, by way of Winchester, Moorefield, Davis, etc., for a distance of 275 miles. Ch. Engr., Wm. A. Hawkins, Richmond, Va.; Pres., W. C. Haight, Bridgeport, Conn.

Northwest.

CHICAGO, MILWAUKEE & ST. PAUL.—Press reports state that this company is planning an extension of the Lake Superior Division from Green Bay, Wis., to Casco Junction, there to connect with Nanapee & Western terminals at Sturgeon Bay City, at the head of Sturgeon Bay. It is the only harbor on Lake Michigan north of Manitowoc, except Kewaunee, which is available for ferry steamers. The St. Paul company will build docks at the head of the bay, and will establish a line of ferries with some east shore city. At that point connection will be had with one of the Eastern trunk lines. The object in establishing a car-ferry system is that the heavy expenses of switching, etc., at Chicago, besides a long haul at the head of Lake Michigan, will be avoided and the cost of hauling lumber for the Eastern markets will be decreased about 33%. It is stated that the Merrill, Antigo & Eastern, or Wisconsin & Michigan road is in on this deal, and that it will unite with the St. Paul in establishing the new line across the lake.

DE KALB & GREAT WESTERN.—Incorporated in Illinois March 22 to construct a railway from a point on the Chicago Great Western at or near Sycamore to the city of DeKalb, in DeKalb county, Ill.; capital stock, $100,000; principal office, at Chicago; directors, Raymond Dupuy, of Chicago; Robt. C. Wight, of St. Paul, and E. C. Lott, of DeKalb.

IOWA, LAKE SUPERIOR & GULF.—Incorporated at Fremont, Neb., to build the Nebraska division of the Gulf & Interstate railway, which is now under construction between Port Bolivar and Beaumont, Tex.; capital stock, $100,000; Pres., J. S. Freeman, Columbus; Vice-Pres., G. C. Davis, Carroll; Secy., J. R. Rundell, Wayne; Treas., J. W. James, Platte Center; Aud., R. R. James, Winside; Solicitor, Dan B. Carey, Fremont; Cashier, E. B. Schutt, Craig; Ch. Engr., R. H. Jones, Winside; Supt. of Const'n, W. R. Carter, Lincoln. The first six named were selected as directors, and J. R. Rundell was chosen chairman.

TERRE HAUTE, OLNEY & CHESTER.—F. N. Boyer, Gen. Man., Olney, Ill., writes us that this railway is projected from Terre Haute, through Fairbanks, York, West York, Oblong, Olney and Cisne to Mount Vernon, 125 miles. Surveys will be made in April. About 20 miles of right of way has been secured, and part of the capital for the construction. The road will have easy grades, with no large streams, and the contracts for the construction will probably be awarded about May 10 or 15.

Southwest.

CENTRAL LOUISIANA.—Hampden Story, Pres., Rayne, La., writes us that this railway is projected from Vermilion Bay, La., through Abbeville, Rayne, and Church Point, to some point on the Texas & Pacific, a distance of about 60 miles. Owing to bad weather the surveys have been delayed. Contracts for the construction will be awarded as soon as possible after the surveys have been completed, and right of way secured. Ch. Engr., Welman Bradford, Rayne, La.

KANSAS CITY, WATKINS & GULF.—A committee of 15 has been appointed at Shreveport, La., to consider a proposition for an extension of this road to that city. Gen. Man., F. S. Hammond, Lake Charles, La.

LOUISIANA EAST & TEXAS CENTRAL.—E. A. Blount, Pres., Nacogdoches, Tex., writes us that this company is a reorganization of the old Red River, Sabine, & Western R. R. Co. The road is projected from San Antonio, Tex., by way of Nacogdoches, New Birmingham and Palestine, to Fort Worth, 240 miles. Estimates have been furnished to the state railroad commission and application will be made for authority to issue bonds. About 100 miles of the route has been located, and 10 miles graded.

SOUTHERN PACIFIC.—A correspondent writes us as follows: The Southern Pacific Co. will let contracts for 25 miles of double tracks, including grading and tracklaying; proposals close April 1. A. Ohuer, Div. Engr., Algiers, La.; or E. B. Cushing, Res. Engr., Houston, Tex.——The company will also build 2 or 3 miles north of the present terminus of the St. Martinsville Branch shortly. This will be a spur track to the celebrated St. John Plantation, but will be on the line surveyed last year to Armandville, and will probably form a part of future extensions to that point. It includes a drawbridge over Bayou Teche.

WICHITA FALLS.—Tracklaying on this railway has now progressed about eight miles west from Henrietta and will reach Wichita Falls, Tex., about April 1.

Rocky Mt. and Pacific.

COLORADO, WYOMING & GREAT NORTHERN.—The reported awarding of contracts within a few days for building this railway, to be 210 miles in length, was noted in our issue of March 7. Press reports state that the grading was commenced at Grand Junction last week. Pres., W. T. Carpenter, Grand Junction, Colo.

MORAGA VALLEY.—Incorporated in California March 21 to build and operate steam or electric railways at Walnut Creek, Contra Costa county, Cal.; capital stock, $500,000, commencing with $35,000; principal place of business at San Francisco; incorporators, Angus A. Grant, Albuquerque, N. Mex.; John T. Williams, Oakland; J. P. Grant, Los Angeles, and A. J. McDonald, and J. A. Burton, of San Francisco.

WASHINGTON & COLUMBIA RIVER.—Plans have been adopted, according to press reports, for reorganizing this company and improving and extending the road. W. B. Tyler, Receiver, is to become president and T. B. Wilcox, of Portland, vice-president.

STREET AND ELECTRIC RAILWAYS.

MANCHESTER, N. H.—A correspondent writes us that the Manchester St. Ry. Co. will begin at once the work of reconstructing its horse railway to an electric road, about 10 miles of which will be built this year. Gen. Man., H. H. Walker.

BOSTON, MASS.—J. W. Ayers has petitioned for a charter for the Metropolitan Ry. Co., which proposes to construct a rapid transit system, estimated to cost $50,000,000.

CANTON, MASS.—The Canton, Sharon & Boston St. Ry. Co. has been organized to build an electric railway 10 miles in length; capital stock, $110,000; Pres., Raymond S. Bryam; Treas., Edward H. Galligan.

FALL RIVER, MASS.—The Fall River & Providence St. Ry. Co. has petitioned for a charter with power to construct an electric railway from Fall River to Somerset and Swansea; capital stock, $250,000; Benjamin Cook is interested.

HULL, MASS.—Geo. F. McKay, 42 Court St., Boston, writes us that contracts have not yet been awarded for the construction of the Nantasket Electric St. Ry., which will be five miles in length. The survey has been made, and location granted. Capital has been subscribed and first assessment paid in. The road will probably be constructed this spring. Pres., Z. Taylor Harrington.

NORTHAMPTON, MASS.—We are informed that the Northampton St. Ry. Co. has awarded contracts to the following for the construction of its electric road from this city to Easthampton, a distance of five miles: Wm. P. Latham, of Florence; Harrington, Robinson & Co., of Boston, and the General Electric Co. The work will be completed by May 10. Pres., John Olmsted, of Springfield; Treas., N. D. Winter; Ch. Engr., Chas. Nichols, of Northampton.

TURNER'S FALLS, MASS.—Press reports state that a company has been organized to build an electric road from this place to Lake Pleasant and Millers Falls, a distance of five miles, at an estimated cost of $80,000. The capital stock of $40,000 is pledged. Work will be commenced as soon as a franchise is granted, and a large power house will also be erected at Millers Falls.

WAKEFIELD, MASS.—We are informed that the contracts have not yet been awarded for the construction of the Wakefield & Stoneham St. Ry. Co.'s extension of its electric road from Stoneham to Reading, a distance of three miles. Right of way and capital have been secured, and the extension will be built at once. Pres., Chas. F. Woodward, of Wakefield; Ch. Engr., Jas. A. Bancroft, of Reading.

CROMWELL, CONN.—It is reported that work will soon begin on the construction of an electric railway to Middletown, Cromwell and Durham, estimated to cost $50,000; Pres., Israel A. Kelsey, West Haven.

LEWISTON, N. Y.—It is reported that the Niagara Falls & Lewiston R. R. Co. will begin the construction of its electric road, seven miles in length, as soon as the weather permits. Pres., J. M. Brinker.

NEW BRIGHTON, N. Y.—The Staten Island Electric R. R. Co. has been granted a franchise.

PORT JEFFERSON, N. Y.—A company is being organized to build an electric railway across Long Island from Port Arthur to Patchogue, a distance of 15 miles; capital stock, $150,000; M. L. Chambers, F. M. Wilson, T. W. Fanning and J. L. Tooker are interested.

LONG BRANCH, N. J.—The West End & Long Branch Ry. Co. has petitioned for permission to equip its road with electricity, and to extend it from Pleasure Bay to Asbury Park. Wilbur A .Heisley is counsel for the company.

CHAMBERSBURG, PA.—The council has been petitioned for a franchise for an electric railway on six streets.

HARRISBURG, PA.—The Harrisburg & Cumberland Electric Ry. Co. has been incorporated to build a road six miles in length in Cumberland county; capital stock, $36,000. It is reported that work will be commenced in a few weeks. Pres., Joseph J. Baughman, of New Cumberland; directors, S. M. Hertzler, of Eberly's Mills; W. L. Gorgas, S. J. M. McCarrell, Frank R. Leib and S. W. Fleming, of Harrisburg.

LOCK HAVEN, PA.—The Lock Haven Traction Co. has been organized, with a capital stock of $300,000, all of which has been subscribed. The company has leased the present electric railway for 999 years, and it is reported that it will at once extend the road to Mill Hall, Salona and adjacent towns, and possibly to the Jersey shore. Pres., C. A. Bragg, of Philadelphia; Vice-Pres., W. H. Mayer, of Lock Haven; Secy., A. J. Martin, 121 Liberty St., New York.

PITTSBURG, PA.—Press reports state that this city is to be connected with Johnstown by an electric railway. The line is to extend from Turtle Creek, 12 miles east of Pittsburg to Johnstown. At Turtle Creek it will connect with the Braddock & Turtle Creek branch of the Second Ave. Electric Ry. of this city. A branch of the Second Ave. line is being built to Carnegie, and when that line is completed about the middle of May, construction on the main line to Johnstown will begin. The Second Ave. Passenger Ry. Co. will build this road.

POTTSTOWN, PA.—The Ringing Rocks Electric Ry. Co. has made surveys and is securing right of way for its road to Gilbertsville and Bayertown, a distance of eight miles. No contracts have yet been awarded. Pres., M. R. Davidheiser; Ch. Engr., R. E. Sheiner, both of this city.

READING, PA.—Press reports state that the Lancaster Ry. Construction Co. is making preparations to begin the building of the Reading & Womelsdorf Electric Ry. early in April. The road is to be finished, according to the contract, by June 1, and it is expected that over 500 persons will be employed in its construction. It will extend from Reading to Womelsdorf, 14 miles, and thence probably to Lebanon, via Sheridan, Newmanstown and Shaefferstown.

BALTIMORE, MD.—An official of the company is quoted as stating that the construction of the first section of the Baltimore & Washington electric railway, between the city limits and a point near Ellicott City, will begin at once, and be completed in about two months. This portion of the line will be owned by the Edmondson Ave., Catonsville & Ellicott City Ry. Co.——The Walbrook, Gwynn Oak & Powhatan R. R. Co. has been granted permission to extend its electric road from Windsor Bridge to Wetheredville. Wm. J. Dickey, Chas. W. Dorsey and J. C. Monmonier are interested.

ASHEVILLE, N. C.—F. M. Miller writes us that a charter has been granted to the Asheville & Biltmore St. Ry. Co. for its electric road, but that the company has not accepted it. It is probable that the project has been given up, at least for the present.

KEY WEST, FLA.—It is reported that the Key West St. Car Association has sold its railway to a number of capitalists, who will equip the road with electricity and extend it to Key Largo.

LONGWOOD, FLA.—E. W. Henck has secured a franchise for an electric road in Orlando. An electric railway will be built between Maitland, Winter Park and Longwood, a distance of about 25 miles.

BUCYRUS, O.—The Inland Electric Ry. Co. has been incorporated to build a road from Bucyrus to Annapolis; capital stock, $50,000; incorporators, M. J. Monnett, A. J. Scott, B. Beal and Edward Volirath.

LORAIN, O.—Press reports state that the right of way for the Cleveland, Lorain and Wellington electric railway lines has been procured, and work on their construction will probably commence May 1. Wayland F. Brown, of Cleveland; J. T. Lawrence and others are interested in the first enterprise, and J. W. Steele, of Oberlin, and James Hoge, of this city, in the latter. Wellington and Amherst citizens are raising a $40,000 bonus for the Wellington & Lorain road. The two roads will connect with the Elyria & Lorain railway in this city, making a total length of 42 miles.

ANDERSON, IND.—We are informed that surveys for Congressman C. L. Henry's electric railway to connect Anderson, Marion, Elwood and Indianapolis will begin about April 1, and contracts will be ready to be let as soon thereafter as possible. H. H. Rogers, Engr.

WABASH, IND.—It is reported that John McDonell and David Overman will be granted a franchise for an electric road from Marion to Independence, a distance of 12 miles.

BARABOO, WIS.—Henry L. Des Anges, of Hoboken, N. J.; D. Harvey, Jr., of Newark, N. J., and E. N. Marsh, of Baraboo, have petitioned for a franchise for an electric road through this place to connect with Kilbourn and Devil's Lake.

DENVER, COLO.—The Citizens' Traction Co. is reported as considering the question of changing the motive power of its Butler St. branch line from cable to electricity at an early date.

LEAVENWORTH, WASH.—The Negro Creek Nickel & Copper Mining Co. is reported about to build an electric railway from a point near Peshastin to its mine, a distance of 11 miles. Vice-Pres., J. W. Arthur.

OREGON CITY, ORE.—The Oregon City & Wilhoit Springs R. R. Co. has been incorporated to build an electric railway between this city and Wilhoit, by way of Molalla; capital stock, $200,000; incorporators, C. H. Canfield, F. K. Arnold, H. H. Johnson and L. L. Porter. This project was noted last week under Railways.

HAYWARDS, CAL.—The supervisors have been petitioned by H. Peterman and Daniel Chrisholm for a franchise for an electric road from Haywards to Mount Eden. Felix Chappellet is interested.

LOS ANGELES, CAL.—The Los Angeles Ry. Co. has been incorporated to build an electric railway; capital stock, $4,000,000, with $3,580 paid in; incorporators, Lovel White, Thomas Brown and Geo. Stone, of San Francisco; John D. Bicknell and W. H. Sherman, of Los Angeles, and A. H. Payson, of San Mateo.——The Los Angeles county board has been petitioned for a franchise for an electric railway. T. E. Newlin, County Clk.——Press reports state that an electric bicycle railway is projected from Santa Monica to San Bernardino, a distance of 75 miles, at an estimated cost of about $2,000,000. It is reported that capital

has been secured and right of way is being petitioned for. Major Barrett, ex-Attorney-Gen. Hart and eastern capitalists are interested.

SAN FRANCISCO, CAL.—It is reported that the Market St. Ry. Co. has prepared plans for a one-story brick power house, 170 × 200 ft., at Bryant and 11th Sts. Work on the construction has been commenced. The Union Iron Works has been awarded the contract for the engines and machinery.

TUCSON, ARIZ.—J. W. Ormsby has been granted a franchise for an electric railway.

HALIFAX, N. S.—The City Electric Transit Co. has been organized by John Q. A. Wentworth, of Boston, Mass.; Robt. C. Geer, of New York, N. Y.; Ephraim Hopkins, of Westchester, Pa., and James M. Pendleton, of Westerly, R. I.

OSHAWA, ONT.—A correspondent writes us that contracts have been arranged for the construction of the Oshawa Ry. between Oshawa Beach and the village of Oshawa, a distance of seven miles, and for the electrical appliances with Ahern & Soper, the Canadian representatives of the Westinghouse Electric Co., but no contracts will be definitely awarded until May 1. Surveys have been made and capital for the construction secured. Ch. Engr., M. J. Butler, Deseronto, Ont.

ELECTRIC LIGHT AND POWER.

WEST RANDOLPH, VT.—It is reported that the question of electric lights is being discussed.

ARLINGTON, MASS.—The committee has reported that an electric light plant of 2,000 lights can be constructed at an estimated cost of $42,700.

PEABODY, MASS.—The committee has recommended the extension of the electric light plant by adding an engine room, with a 280-HP. engine, and making other improvements, estimated to cost $16,000. The committee consists of Chas. C. Dodge, N. M. Quint and W. F. Munroe.

WINCHESTER, MASS.—The proposition to issue $40,000 in bonds for an electric light plant is reported about to be voted upon

CHATHAM, N. Y.—Bids are asked until April 8 for furnishing 85 incandescent lights for five years. W. B. Daley, Village Clk.

MOUNT MORRIS, N. Y.—The people have voted to award a contract for an electric light plant.

NEW YORK, N. Y.—Bids are asked by the police department until April 5 for furnishing and installing electrical conductors.

SALEM, N. Y.—The trustees have granted a franchise for lighting this place by electricity, power to be furnished from Rexleigh.

TRENTON, N. J.—A bill has passed the house authorizing this city to issue bonds for an electric light plant.

PITTSBURG, PA.—Bids are asked until April 8 for the electrical installation for the Fifth Ave. high school building. Arch., Edward Stotz; Chas. Reisfar, Jr., Secy. Bd. Education.

TAMAQUA, PA.—Samuel Beard, Town Clk., writes us that there is no probability of an electric light plant at present.

BALTIMORE, MD.—The electrical subway commission has awarded a contract for the equipment of the underground police and fire alarm telegraph to the Western Electric Co., of New York, at $56,780, for double cables. The bids were as follows: For single cable—The John A. Roebling Sons Co., $2.. 031; Standard Underground Cable Co., $27,408; Western Electrical Co., $29,974. For double cables—John A Roebling & Sons, $38,204; Standard Underground Cable Co., $34,659; Western Electrical Co., $36,780. Engr., N. S. Hill, Jr.

KINSTON, N. C.—It is reported that an election will soon be held to vote on a proposition to issue $40,000 in bonds for an electric light plant and water-works.

ATLANTA, GA.—H. M. Atkinson has prepared plans for an electric light plant of 1,000 HP., 500 arc lights of 2,000 c. p. and 10,000 incandescent lights, for the exposition grounds and buildings.

ELBERTON, GA.—Bids are asked until April 22 for the purchase of $12,000 in bonds for an electric light plant. W. B. Henry, Clk.

BARDSTOWN, KY.—Bids are asked by the council for an electric light plant, and also for lighting the city for 20 years. Address Arvil Arnold.

MARTIN'S FERRY, O.—The council has passed an ordinance providing for an issue of $30,000 in bonds for an electric light plant.

NORWOOD, O.—The council has passed a resolution to vote on the question of issuing $30,000 in bonds for an electric light plant.

WILLOUGHBY, O.—Bids are asked until April 17 for erecting an electric light plant. C. C. Jenkins, Cy. Clk.

BENTON HARBOR, MICH.—Peter English has petitioned for a franchise for an electric light plant, power to be furnished by damming the Paw Paw River one mile above this place.

OXFORD, MICH.—An election will be held March 30 to vote on the question of issuing $25,000 in bonds for an electric light plant.

BLOOMINGTON, ILL.—Press reports state that the power house, including the steam and electric plant, of the Bloomington Electric Light & Power Co. was destroyed by fire March 18; loss, $75,000; insurance, $40,000.

LANCASTER, WIS.—Edward Pollock has been granted a franchise for an electric light plant, which is to be in operation in six months.

COLORADO CITY, COLO.—It is reported that a propositon to build an electric light plant, estimated to cost $18,000, will be voted upon in April.

PENAWAWA, WASH.—It is reported that Henry Cram is about to put in an electric light plant to furnish power for pumping water for irrigation purposes.

SEATTLE, WASH.—A bill has passed the legislature authorizing an appropriation of $50,000 for the erection of a power house, etc., at the state university.

SALT LAKE CITY, UTAH.—Bids are asked by the Citizens' Electric Light Co. for the construction of a 1½-story power house, 67 × 88 ft. It will contain six boilers and three compound engines. Pres., Charles Boettcher.

SANTA CRUZ, CAL.—It is reported that the F. A. Hihn Co. proposes to construct an electric light plant at Felton and to transmit the power to this city, a distance of five miles.

STRATFORD, ONT.—Bids are asked until April 13 for 73 to 85 arc lights for street lighting for five years from Nov. 1; also for 100 incandescent lights for city hall. Wm. Hepburn, Chn. Com.

NEW COMPANIES.—Canton Light, Heat & Power Co., Canton, O.; capital stock increased from $50,000 to $150,000.

Greenville Electric Light, Heat & Power Co., Greenville, Ill.; $25,000; Ernest G. Bruckman, S. E. Bruckman.

Dover Electric Light & Power Co., Dover Plains, N. Y.; $10,000; Adolph Reimer, Dover Plains; Julius C. Minck, Brooklyn.

Jandus Electric Co., Cleveland, O.; name changed from Cuyahoga Mfg. Co., and capital stock increased from $25,000 to $100,000; Secy., J. Potter; Treas., Chas. H. Rockwell.

Electric Construction & Supply Co., New York, N. Y.; $12,000; Arthur A. Lawrence, Chas. F. Parmley, New York; W. S. Perry, Staten Island; Chas. E. Rocap, Plainfield, N. J.

Pacific Power Co., San Francisco, Cal.; $500,000, full amount paid in; W. A. Aldrich, Henry F. Teschemacher, San Francisco; G. W. Howard, San Mateo; A. W. Bowman, Oakland.

Providence Electric Thermostat Co., Providence, R. I.; $100,000; to manufacture heat and damper regulators; Pres. and Treas., Loren M. Cook, Providence; Clk., F. E. Rowell, Kittery, N. H.

Interstate Power Co., South Bend, Ind.; to dam the St. Joe River near Bertrand to supply power to South Bend, Niles, Buchanan and Berrien, and for an electric railway between South Bend and St. Joseph; Fred E. Lee, Dowagiac, Mich.; Marshall L. Howell, Callipolis; R. D. Dix, Berrien Springs; J. B. Collins, Michigan City.

BRIDGES.

MANCHESTER, N. H.—The city has been granted the right to borrow $200,000 for a new bridge across the Merrimack River at Granite St., but we are informed that the city has not yet acted in the matter. W. H. Bennett, Cy. Engr.

COHOES, N. Y.—The governor has signed bills appropriating $8,000 for two bridges across the canal in this city.

FAIRPORT, N. Y.—The governor has signed a bill for constructing a bridge across the canal at this place to cost $6,500.

LITTLE FALLS, N. Y.—H. W. Warren, Cy. Clk., writes us that a bill is before the legislature asking for an appropriation of $25,000 for proposed bridges at this place, but that it does not progress very rapidly.

OGDENSBURG, N. Y.—Bids are asked until April 12 for a 220-ft. steel plate girder bridge, as stated in our advertising columns. S. H. Palmer, Chn. Comrs.

STAPLETON, N. Y.—Henry P. Morrison, Engr. County Roads, writes us that the plans and specifications for a steel draw of 90 ft., and a wooden trestle 1,820 ft. in length, together with two bulkhead cribs, to be constructed across the Fresh Kills Creek and marsh in this county, will be completed within a few days. At the next meeting of the board of supervisors, April 1, it is probable that some steps will be taken toward advertising for bids for the work.

NEW BRUNSWICK, N. J.—The governor has signed a bill authorizing Middlesex county to issue $150,000 in bonds for bridges.

TRENTON, N. J.—Bids will soon be asked for a 60-ft. iron span to replace the old Lawrenceville road bridge, according to reports. N. H. Furman, Chn. Com.

PHILADELPHIA, PA.—The Pencoyd Iron Works has been awarded the contract by the Pennsylvania R. R. Co. for the superstructure for its bridge across the Delaware River above this city. The contract calls for nearly 7,000 tons of steel, and the work is to begin by Aug. 1 and be completed about Jan. 1, 1896.

WILKES BARRE, PA.—The city clerk writes us that no definite action has yet been taken in regard to the proposed bridge across the railway tracks.

ATLANTA, GA.—R. M. Clayton, Cy. Engr., informs us that the following bids were received March 18 for constructing the Broad St. bridge:

Edgemoor Bridge Co., Wilmington, Del.	$22,200
A. J. Hageman, Chicago, Ill.	22,265
Wisconsin Bridge & Iron Wks., Milwaukee, Wis.	22,500
King Bridge Co., Cleveland, O.	23,000
Wrought Iron Bridge Co., Canton, O.	23,000
Phoenixville Bridge Co., Phoenixville, Pa.	23,840
Pittsburg Bridge Co., Pittsburg, Pa.	24,870
Youngstown Bridge Co., Youngstown, O.	24,999
Toledo Bridge Co., Toledo, O.	26,167
Jasper Construction Co., Jasper, Ala.	24,900
Gude & Walker, Atlanta, Ga.	26,300
Grant Wilkins, Atlanta, Ga.	26,500
Nelson & Buchanan, Chambersburg, Pa.	27,300
Watkins & Hardaway, Birmingham, Ala.	28,000

There were also several informal bids. The bridge committee will recommend that the contract be awarded to the Edgemoor Bridge Co.

ABBEVILLE, LA.—We are informed that the parish of Vermilion will build a drawbridge over Bayou Vermilion. Address C. H. Edwards, Pres. Police Jury.

DANDRIDGE, TENN.—It is stated that the county court will be asked to make an appropriation to build a bridge across the French Broad River at this place at its April session. The bridge is much needed.

CINCINNATI, O.—Bids are asked by the board of administration until April 16 for the substructure and superstructure of a viaduct 550.42 ft. in length, as stated in our advertising columns.

CLEVELAND, O.—The Cleveland Electric Ry. Co. has voted to subscribe $1,000 to aid in the construction of a proposed bridge over Nine Mile Creek, under the conditions that it be permitted to have two tracks across the bridge, that the bridge be 40 ft. wide and that the abutments cost not less than $2,500.

AUBURN, IND.—Bids are asked until April 16 for the erection of three bridges. Frank A. Borst, Audr.

INDIANAPOLIS, IND.—Press reports state that the Lake Erie & Western R. R. Co. will spend considerable money in betterments this year. A steel bridge will be built at the crossing of the Mackinaw between Bloomington and Peoria, and 12 wooden bridges will be replaced with iron. New masonry will be built and 300,000 new ties will be put in. The amount of new steel that will be laid has not been settled yet. All the stations will be overhauled and a number of them will be required.

INDIANAPOLIS, IND.—Bids are asked until April 2 and 9 for constructing bridges. The Spruce St. bridge will be let April 2, and is of 75 ft. span, 30 ft. width, 7 ft. 6 ins. depth of girder, 15 ft. 3 ins. span of I-beams. It will have a 3-in. double plank floor, and will be designed for 100 lbs. per sq. ft. of rolling load, the size of floor system being prescribed. The Raymond St. bridge over Pleasant Run and the Pratt St. bridge over the canal will be let April 9. The first is of 78 ft. span and 7 ft. 6 ins. depth of girder, 30 ft. span of floor beams and 15 ft. span of I-beams for floor. Rolling load of 100 lbs. on roadway and 80 lbs. on sidewalk. The Pratt St. bridge is 66 ft. span and 6 ft. depth of girder, 24 ft. wide, and 14 ft. 6 ins. span of I-beams. It will be designed for 100 lbs. per ft. on a 12 T-roller.

RICHMOND, IND.—We are informed that the bridge mentioned some time ago is still under consideration by the county commissioners, with the probability of being built.

EVART, MICH.—It is reported that a bridge on the Flint & Pere Marquette R. R., one mile west of this place, gave way under a freight train March 18, wrecking the bridge and 11 freight cars.

GALESBURG, MICH.—It is reported that the construction of a new bridge across the river, estimated to cost $15,000, is being considered.

GLADSTONE, MICH.—Press reports state that the contract for the building of an iron bridge over the Escanaba River, three miles west of this city, has been let to the Gillett-Herzog Mfg. Co., of Minneapolis, at $5,700. The bridge will have a span of 227 ft., and is to be completed by Sept 1. There were ten bids submitted.

ST. PAUL, MINN.—Bids are asked until April 2 for the construction of the superstructure of an iron bridge on Como Ave. T. A. Prendergast, Cy. Clk.

CHILLICOTHE, MO.—Bids are asked until April 3 for constructing the Vaughan bridge across Mound Creek and also for repairing a wire bridge over Mud Creek. J. Broaddus.

ST. JOSEPH, MO.—The city engineer has prepared plans for a viaduct from Sixth to Eighth Sts., estimated to cost $27,500 to $29,000.

DENVER, COLO.—Bids are asked until April 1 for erecting two temporary pile bent trestle bridges across Cherry Creek. A. C. Harris, Pres. Bd. Pub. Wks.

HOUSTON, TEX.—A proposed extension of the Southern Pacific railway north from St. Martinsville, La., will include a drawbridge over Bayou Teche. Address E. B. Cushing, Resident Engr., Houston.

BUILDINGS.

MANCHESTER, N. H.—We are informed that there is renewed talk of a new passenger station in this city.

BUFFALO, N. Y.—An eight-story office building is to be built at 516 to 518 Main St. The names of the men who are to build it are being withheld until a contract for building it is made. It will probably cost about $100,000.——F. W. Clark, of Chicago, who has the contract for building the Ellicott Square block, has awarded the contract for the steel construction of the building to the Carnegie Steel Co., of Pittsburg, and for the terra cotta work to the Perth Amboy Terra Cotta Co., Perth Amboy, N. J.

BUFFALO, N. Y.—The board of public works will advertise for competitive designs for the construction of a new east side high school building, at a cost not to exceed $150,000, the best design to receive the award for the doing of the work, with 3½% for preparing the plans, specifications and details. The next five designs to receive $100 each. R. G. Parsons, Secy. Bd. Pub. Wks.——The bureau of building has issued a building permit to the projectors of a 13-story building at the corner of Church and Pearl Sts. The stated cost of the structure is $600,000.

NEW YORK, N. Y.—Plans have been filed by J. G. Wallace, 236 East 50th St., for the erection of a 15-story brick office building at 25 to 29 William St., to cost $800,000, and by Philip Braender, 15 East 93d St., for an eight-story brick warehouse at 15 93d St., to cost $120,000.——McElfatrick & Sons nave prepared plans for a music hall at Broadway and 44th St. for Oscar Hammerstein.

ELIZABETH, N. J.—Bids are asked by the committee until April 10 for erecting a school building on East Jersey St. Arch., D. B. Provoost.

ALTOONA, PA.—Harvey Linton, Cy. Engr., writes us that the proposition to issue $50,000 in bonds for a new city hall was defeated at an election March 22. It is probable that the committee will authorize the remodeling of the old city hall, at an expense of from $12,000 to $15,000.

BALTIMORE, MD.—Plans have been prepared by Baldwin & Pennington for the rebuilding of the City College building, which will be of granite and brick, 224 × 156 ft., and will cost $236,000. The contractor for the erection of the building is Henry S. Rippel. Crook, Horner & Co. are to provide the heating and ventilating apparatus, and the plumbing and gasfitting are to be done by George W. Walthen & Co.

KING GEORGE, VA.—Bids are asked until April 12 for erecting an 18 × 28-ft. brick jail. W. S. Braus, Clk. County Bd.

RALEIGH, N. C.—It is reported that plans are wanted for a three-story jail, to contain about 200 cells, and estimated to cost $25,000. Address Elias Carr, Governor, for information.

DAWSON, GA.—Bids are asked until April 30 for the construction of a jail. J. W. Roberts.

CHARLESTON, S. C.—Bids are asked by the Exchange Banking & Trust Co., according to reports, for the erection of a brick opera house, estimated to cost about $150,000.

NEW ORLEANS, LA.—Bids are asked until May 1

for the metalwork and also for the buildings for the Brazos River light station, as stated in our advertising columns. Maj. James B. Quinn, U. S. Lighthouse Engr.

CHATTANOOGA, TENN.—The council is to petition the legislature for an appropriation of $100,000 for the erection of a new city hall.

DETROIT, MICH.—Bids are asked until April 15 for furnishing seven skeleton iron towers for Hay Lake Channel, as stated in our advertising columns. Maj. M. B. Adams, U. S. Lighthouse Engr.

MARMONT, IND.—Plans have been prepared for the rebuilding of the Culver Military Academy, which was recently destroyed by fire. The new building will be of brick and stone, and will cost about $200,000.

ANDERSON, IND.—We are informed that W. S. Kaufman, of Richmond, Ind., is preparing plans for a masonic temple to be built at this place.

CHICAGO, ILL.—The health commissioner has received the following bids for the construction of the new smallpox hospital:

Joseph Stamson & Co.	$117,650
William Fallis & Co.	124,850
D. H. Hayes & Co.	126,973
Busse & Gleason	135,000
Opperfelt & Turner	139,939
L. L. Leach & Co.	142,733
T. E. Courtney	152,443
William Mayer & Co.	162,997

SALINA, KAN.—Bids are asked until April 12 for the erection of a U. S. public building at this place. Address Chas. E. Kemper, Acting Supervising Arch., Washington, D. C.

HELENA, MONT.—The governor has signed the bill for the erection of a capitol building, estimated to cost $1,000,000.

SAN MARCOS, TEX.—Bids are asked until April 24 for the construction of a dwelling house, office and workshop for the U. S. fish commission, as stated in our advertising columns. Address Marshall McDonald, U. S. Fish Comr., Washington, D. C.

DENVER, COLO.—The Colorado Mining & Industrial Exposition has been incorporated with a capital stock of $1,000,000; incorporators, D. H. Moffatt, J. B. Grant, J. K. Choate, F. W. Wolcott, and J. L. Brush.

WATER-WORKS.

MECHANIC FALLS, ME.—The town has voted an appropriation for hydrant rental, and has appointed a committee, consisting of J. W. Penny, F. H. McDonald and J. M. Libby, to confer with a company in regard to putting in works this summer.

WILTON, ME.—The citizens are reported as endeavoring to raise money to put in a pump and main for fire protection.

YARMOUTH, ME.—The town has voted to construct works to cost $40,000. F. W. Buckham, Clk.

SOMERSWORTH, N. H.—The mayor has urged the importance of the city's acquiring the sole ownership of the works as soon as practicable.

LYNDONVILLE, VT.—Bids are asked until April 10 for the construction of works, as stated in our advertising columns. Engr., John W. Burke.

ST. ALBANS, VT.—H. A. Warren, Supt., has recommended that new 6 and 8-in. mains be laid in seven streets.

BRAINTREE, MASS.—The question of issuing $20,000 of additional water bonds has been indefinitely postponed by the town.

EAST PEPPERELL, MASS.—The question of putting in works has been postponed until the next town meeting.

LEOMINSTER, MASS.—A. L. Burditt and W. J. Lewis have been appointed a special committee to investigate the water question.

LYNN, MASS.—The aldermen have voted to take 135 acres of land in the towns of Saugus and Lynnfield for the purpose of building a dam and establishing a water basin.

NORTH BROOKFIELD, MASS.—At a special town meeting March 21 it was voted to sustain the water commissioners in asking the legislature to allow the town to borrow $30,000 more to extend the work. T. C. Bates, Chn. Comrs.

SOUTHAMPTON, MASS.—At a town meeting last week it was voted to investigate the question of works for fire protection still further, and the committee was instructed to report at the next meeting. In the mean time the property owners will be asked to contribute towards the construction of works.

WILMINGTON, MASS.—This town has petitioned for authority to construct works, the supply to be taken from Silver Lake, midway between Boston and Lowell.

WEST HAVEN, CONN.—The West Haven Water Co. is reported as about to make important improvements, including the raising of the dam.

BROOKLYN, N. Y.—Bids are asked until April 11 for a supply of 30 and 20-in. cast iron water pipe, as stated in our advertising columns. Alfred T. White, Comr. Cy. Wks.

BROCTON, N. Y.—The clerk writes us that the water-works proposition was defeated at the election last week.

FORESTVILLE, N. Y.—S. W. Reynolds, Chn. Comrs., writes us that bids will not be asked for the construction of works until an engineer has had time to prepare the necessary plans and specifications. No engineer has yet been engaged.

GREENPORT, N. Y.—This village has been authorized to purchase the property of the Greenport Water Co. and to issue $50,000 in 4% 30-year water bonds.

KNAPP CREEK, N. Y.—It is stated that Beattie & Son have purchased the works; possession to be given April 1.

MADISON, N. Y.—It is reported that an engineer from Syracuse is making surveys for works at this place.

MEDINA, N. Y.—The water company is reported as about to place additional pumps at the wells at the pumping station, and if the supply is then found inadequate, to drill more wells.

MIDDLEVILLE, N. Y.—Steps are being taken to secure works. At a recent meeting of the citizens it was decided to employ an engineer to make plans H. E. Jackson was chairman and W. E. Auteurith was clerk of the meeting.

MONTICELLO, N. Y.—At a charter election last week the ticket favoring the construction of works was elected by a majority of 77. The works will probably cost about $20,000. David S. Avery, Village Pres.

NEW HARTFORD, N. Y.—The incorporation of the New Hartford Water Co. was noted last week. This company acquires all the rights and franchises owned by I. L. Terry and C. L. Jones and will improve and extend the works.

OLEON, N. Y.—There is talk of adopting the meter system, but no definite action has yet been taken.

SOUTH OTSELIC, N. Y.—It is stated that pipe for the proposed water-works has arrived and that there is now talk of putting in electric lights.

PATCHOGUE, N. Y.—The talk of works at this place is noted in a letter published under Streets and Roads.

WEST TROY, N. Y.—Bids are asked until April 25 for constructing water-tower, equipping same with tank, filters, pipes, etc., and for laying water mains. Maj. Isaac Arnold, Jr., Ord. Dept., Watervliet Arsenal.

CLAYTON, N. J.—The Borough of Clayton Water Co. was incorporated March 26 with a capital stock of $75,000; incorporators, Edwin F. Partridge, H. B. Hodge and J. S. Keen, Jr., of Philadelphia; J. M. Moore, M. F. Dubois and Harry Steelman, of Clayton, and others.

JERSEY CITY, N. J.—The Jersey City Water Co. was incorporated March 23; capital stock $100,000, all paid in; incorporators, E. P. Sevenson, S. A. Sevenson, F. B. Tilghman and others.—The bids submitted March 25 for furnishing a supply for 25 years are noted at length elsewhere in this issue.

MEDFORD, N. J.—The Medford Water Co. was incorporated March 26 with a capital stock of $9,000, by I. W. Stockes, J. C. Hinchman, R. B. Allen and others.

EAST GREENVILLE, PA.—It is stated that O'Reilley Bros., contractors for the works, will begin the construction as soon as the weather will permit.

EAST HARRISBURG, PA.—The East Harrisburg Water Co. is being organized by G. Schinneller, H. S. Duke, J. C. Bucher and others who are said to be interested in the Boiling Springs water supply.

MEADVILLE, PA.—The council has appointed a committee of five to confer with the water company in an endeavor to agree upon a price at which the city can purchase the works. Bids for constructing new works were to have been opened March 27, but W. R. Vance, Cy. Clk., writes us that the date has been postponed until April 6. The water company has applied for an injunction to prevent the building of new works, and a hearing will be held March 28.

MONACA, PA.—W. J. Millon, J. R. Potter and others have been appointed to confer with the council and urge immediate action for the construction of works.

PHILADELPHIA, PA.—Bids are asked until April 6 for installing a suction pipe at the League Island navy yard. Address E. O. Matthews, Chf. of Bureau of Yards and Docks, Washington, D. C.

WASHINGTON, PA.—The water company is reported to have decided to build a large reservoir this spring, the work including a dam 90 ft. long and 20 to 25 ft. high.

BALTIMORE, MD.—Bids are asked until April 3 for a supply of Omaha pig lead. William L. Kenly, Acting Ch. Engr.—The water board is reported to have decided to engage S. M. Gray to prepare plans for a proposed extension of the service through the Annex.

HAGERSTOWN, MD.—It is stated that the Washington County Water Co. will soon purchase a new 30-HP. engine for the Heyser St. pumping station. It is expected that another survey will soon be made near Raven Rock for an additional supply.

ROCKVILLE, MD.—Several meetings have been held recently to discuss the question of works. Professor Welty, of the Maryland Agricultural College, is reported to have made surveys for a supply from Rock Creek.

SHENANDOAH, VA.—The council is reported as considering the question of works.

KINSTON, N. C.—It is reported that an election will soon be held to vote on an issue of $40,000 in bonds for works and electric lights.

DEMOPOLIS, ALA.—It is stated that the city has definitely decided to put in works.

CUTHBERT, GA.—The contract for constructing works, as advertised in Engineering News, is reported to have been awarded to Herbert & Lapeyre, Chattanooga, Tenn., at $37,893. It is stated that there were 35 bids.

GREENEVILLE, TENN.—Press reports state that a local company has been organized to construct works.

GREENFIELD, TENN.—A contract for a water tower for the works has been awarded to W. C. Criswell, of Milan.

LOUISA, KY.—It is reported that the question of constructing works is being investigated by the citizens.

CADIZ, O.—The contract for works has been awarded to L. G. Hallock, of Wheeling, W. Va., and Ward Bros., of Cadiz, at $25,446, according to a press report.

CARROLLTON, O.—A press report states that the pumping station at Minerva Junction has been destroyed by fire.

EVANSTOWN, O.—Bids are asked until April 6 for laying about 10,630 ft. of 6-in. pipe, with valves, hydrants, etc. Chas. A. Ewing, Engr., 36 Carlisle Bldg., Cincinnati.

BRIGHTWOOD, IND.—The contract for works was recently awarded to the U. S. Wind Engine & Pump Co. of Batavia, Ill. The water board has since selected the following materials: Bourbon hydrants, Rensselaer valves and boxes, Chandler & Taylor boilers, Stillwell heaters and Worthington pumps, and it is expected that the laying of the mains will soon be commenced.

GREENFIELD, IND.—The council has voted to issue $5,000 in water bonds.

MADISON, IND.—Bids are asked until April 4 for the lease of the works and the furnishing of the city with a daily supply of 4,000,000 gallons for 15 years. We are informed that the lessee must put in a pumping engine having a capacity of over 1,000,000 gallons per day, together with new boilers, the entire plant to become the property of the city at the end of 15 years unless the contract is terminated at the end of 10 years. George B. Clark, Cy. Clk.

ADRIAN, MICH.—The water company is reported to have decided upon plans for important improvements, including a filter system.

OXFORD, MICH.—A special election will be held March 30 to vote on an issue of $25,000 in bonds for works and an electric light plant. This question was voted on last fall, the bonds issued and sold and the contracts all awarded, but it has now been discovered that some of the proceedings were illegal, and a new election is necessary.

BLOOMINGTON, ILL.—The city is reported as in danger of a water famine. The present supply is from one large open well and a gang of 15 tube wells, which are at present inadequate.

CHICAGO, ILL.—It is stated that the $150,000 appropriated for extensions, noted last week, will be spent for a battery of seven new boilers and a new 15,000,000-gallon pumping engine and other improvements at the Chicago Ave., Lake View and 68th St. pumping stations.

CUBA, ILL.—It is reported that the citizens have voted to issue $2,000 in water bonds.

LINCOLN, ILL.—F. M. Mills, of Des Moines, Ia., has purchased a controlling interest in the Lincoln Water, Light & Power Co.'s plant, valued at $250,000.

MAYWOOD, ILL.—Bids are asked until April 11 for constructing works, as stated in our advertising columns. Engrs., Hill & Enright, Chicago; Samuel H. Donaldson, Jr., Village Clk.

LA CROSSE, WIS.—John A. Cole, of Chicago, has been engaged to furnish plans and specifications and superintend the erection of the new 10,000,000-gallon pumping engine.

SPARTA, WIS.—It is reported that the following bids were received March 19 for the construction of a complete system of water-works:

U. S. Wind Engine & Pump Co., Batavia, Ill.	$30,994
Challenge Wind Mill & Feed Mill Co., Batavia.	29,365
Sykes & Wagner, Minneapolis.	28,886
O. H. Olson, Stillwater, Minn.	32,454
P. M. McDonald, Duluth, Minn.	31,700
Leshe & Green	30,094
William Forrestal, Milwaukee.	27,000
M. C. Burke, West Superior.	31,300
Geo. C. Morgan, Chicago.	31,944
W. H. Wheeler & Co., Beloit.	28,950
Charles W. Thompson.	28,890
James A. Trane, La Crosse.	31,346
Winona Construction Co., Winona.	35,500
Fairbanks, Morse & Co., Chicago.	33,008
A. F. Fetter, La Crosse.	30,987
G. B. Smith, Sparta.	27,300

As the city voted only $22,000 in bonds, all bids were rejected. The council afterwards invited some of the lowest bidders to make propositions whereby they might reduce the cost $3,000 or $4,000. Sykes & Wagner submitted a proposition to put in an engine house with two 1,000,000-gallon capacity pumps, with five miles of pipe and steel standpipe or tower 70 ft. high, for $24,989 with brick smokestack for an engine house, or $24,500 with steel stack.

WAUPUN, WIS.—It is now claimed that the proposition to issue bonds for works was not carried by a sufficient majority at the election Nov. 13, and that the contracts are accordingly invalid, but the citizens are reported as in favor of works and it is not thought that the present contracts will be effected.

CENTERVILLE, IA.—It is stated that steps are being taken to secure works.

DAYTON, IA.—Bonds have been voted for works.

OTTUMWA, IA.—The water committee is reported as contemplating putting in a Jewell filter plant to cost from $22,000 to $25,000.

WESLEY, IA.—The citizens have voted to issue $5,000 in bonds for works.

RENVILLE, MINN.—It is reported that $30,000 in bonds has been voted for works.

ST. PAUL, MINN.—A bill has been introduced in the legislature appropriating $12,000 for a water supply system at the state fair grounds.

VALLEY CITY, N. DAK.—The contract for works has been awarded to the U. S. Wind Engine & Pump Co., of Batavia, Ill., at $9,380.

HAVENSVILLE, KAN.—It is reported that the citizens will soon vote on an issue of $2,500 in bonds for works.

TOPEKA, KAN.—The Topeka Water Co. is reported to have commenced on improvements to cost $18,000.

FORT SHAW, MONT.—Bids are asked for the construction of works at the U. S. Indian Industrial School at this place. W. H. Winslow, Supt.

AUSTIN, TEX.—The mayor has recommended that a special election be held to vote on an issue of $260,000 in water and light bonds for the purpose of meeting a deficiency of $50,000 and to build a reservoir and lay additional mains.

COLEMAN, TEX.—J. S. Thatcher, Engr., Dallas, writes us that the following bids were received for constructing the proposed works:

Brown & Dabney, Dallas, Tex.	$14,500
J. Sphar, Dallas, Tex.	14,500
J. W. Moore, Lampasas, Tex.	14,240
O. J. Gorman, Dallas, Tex.	14,150
Carlisle & Broughal, Kansas City.	14,177
J. M. Carter, Abilene, Tex.	14,095
Jaeger & Blanchard, Rich Hill, Mo.	13,940
W. E. De Long, Arkansas.	13,366
C. W. Alcott, Dallas, Tex.	13,292

The contract was awarded to C. W. Alcott. There was also quite a large number of bids for materials and separate portions of the work.

CORPUS CHRISTI, TEX.—The Corpus Christi Water-Works Co. has given notice that it will apply to the legislature for permission to construct a dam across the Nueces River in Nueces and San Patricio counties.

CORSICANA, TEX.—One year ago a contract was

signed for boring three artesian wells, and a daily supply of 300,000 gallons of water was obtained last week. It is said that mains will soon be laid.

GOLIAD, TEX.—The Goliad Water & Light Co. will probably put in works at an early date. W. B. Campbell, Pres.

MINERAL WELLS, TEX.—It is stated that a contract for works has been awarded and that construction will be commenced this week.

TEMPLE, TEX.—The Temple Water-Works Co. has awarded a contract for a large reservoir.

ALVA, OKLA.—The city has voted to issue $13,000 in bonds for works.

PROVO CITY, UTAH.—The council has voted to lay about 4,000 ft. of 4-in. pipe, at a cost of $1,600.

HAMILTON, ONT.—The committee is considering plans for increasing the water pressure. It is stated that a new reservoir, with duplicate pumping engines, would cost $98,800, a third main on Cannon St. $134,750, and a new stand-pipe in the southern district $96,000.

SUDBURY, ONT.—Bids are asked until May 1 for the construction of works and a sewer system. Engrs., Gordon & Rorke, Sudbury. A. Ferris, Town Clk.

DIGBY, N. S.—Bids are asked until April 18 for the construction of works, including 7¾ miles of 10 to 4-in. pipe line, a masonry dam and a 500,000-gallon reservoir. T. C. Shreve, Mayor.

IRRIGATION.

TOPEKA, KAN.—Press reports state as follows: The state irrigation board was in session in this city March 21. Commissioner Frost has selected the location for the three plants in the southwestern district, as follows: One near the east line of Hamilton county, one near Ulysses in Grant county and one near Cimarron in Gray county. Commissioner Sutton has selected Oakley for one plant, and will place the other in Scott or Greeley county. Commissioner Tomblin will establish one plant at Goodland and another near Almena, Norton county. Commissioner Frost expects to use wind power to pump water. Commissioner Tomblin will try gasoline engines.

ORD, NEB.—Press reports state that Mr. Lee, a Boston capitalist, has been at this place in the interest of an irrigating ditch on the north side of the river. The first intention was to have it commence some six miles below Ord and extend down to Scotia. The plan now is to start near Burwell, which would make the ditch about 40 miles long. It is proposed to build the ditch without any aid in the way of a bonus or donation, and to put in laterals and have everything in shape for watering the land at less than $1.50 per acre.

NEW COMPANIES.—Prescott Irrigation Co., Prescott, Wash.; $7,000; J. A. Johnson, Henry Ibberson, O. K. Purdy.

North, Middle & South Texas Drain, Land & Irrigation Co.; $30,000; R. P. Smyth, J. C. Carter, S. B. Tofton, N. K. Smith, J. M. Tracker.

West Side Canal & Land Co., San Francisco, Cal.; Cucamonga Land & Irrigation Co., Los Angeles, Cal.; $50,000, with full amount paid in; I. W. Hellman, San Francisco; Peter D. Martin, Max Mayberg, Ozra W. Childs, Los Angeles.

$5,000,000, with $25,000 paid in; to build canals for irrigation purposes; William Strader, Coalinga, Fresno county; H. W. Gray, A. B. Dobbins, Wm. J. Smith, San Francisco.

SEWERAGE.

MANCHESTER, N. H.—W. H. Bennett, Cy. Engr., writes us that the commissioners will build about 3½ miles of brick and pipe sewers.

ST. ALBANS, VT.—The trustees have recommended that a committee be appointed to investigate the question of constructing a system.

ATTLEBORO, MASS.—Wm. J. Luther writes us that no sewers are likely to be constructed this year.

ANDOVER, MASS.—The commissioners have recommended the construction of a system for a portion of the city, with outlet into the Merrimac River, on plans prepared by McClintock & Woodfall, of Boston. The estimated cost is $127,500. W. S. Jenkins, Chn. Comrs.

FITCHBURG, MASS.—David A. Hartwell, Cy. Engr., writes us that action will probably be taken in April regarding plans and estimates for the proposed trunk sewer.

SALEM, MASS.—The aldermen have voted to appropriate $50,000 for a trunk sewer in Derby St.

WOBURN, MASS.—It is reported that the commissioners are ready to award contracts for constructing sewers as soon as the council provides the funds.

WEST NEWTON, MASS.—Bids are asked until April 11 for a supply of sewer pipe and castings, as stated in our advertising columns. H. D. Woods, Cy. Engr.

BIRMINGHAM, CONN.—The extension of sewers in two streets is being considered.

BRISTOL, CONN.—We are informed that Weand & Lesher, of Reading, Pa., have been awarded the contract for constructing the system, estimated to cost about $55,000. Miles L. Peck, Warden.

ROCKVILLE, CONN.—S. M. Gray, of Providence, R. I., has been engaged to design a system, for $1,435. The system will be about 18 miles in length, and is estimated to cost about $125,000.

WINDSOR LOCKS, CONN.—The council will soon consider the report of the committee appointed last November to investigate the question of constructing a system, according to reports.

BUFFALO, N. Y.—The board of public works is preparing plans and specifications, and will advertise for bids, for the construction of a 10 and 12-in. pipe sewer in Florida St., from Daisy Place to 100 ft. west of Humboldt Parkway.

NEW ROCHELLE, N. Y.—Bids are asked for constructing about 2,500 ft. of 8 and 6-in. pipe sewers. J. K. Wilkes, Cy. Engr.

MORRISTOWN, N. J.—It is proposed to construct a system, at an estimated cost of $160,000, according to reports.

NEW BRUNSWICK, N. J.—Plans have been prepared by Asher Atkinson, Cy. Surv., for constructing about five miles of sewers in five streets, at an estimated cost of about $25,000. It is also proposed to construct sewers in three wards, estimated to cost $80,000.

PLAINFIELD, N. J.—The city received 19 bids March 25 for constructing about 17 miles of sewers, the lowest being M. Honan & Sons, Chester, Pa., at $41,828. The council will meet April 1 to award the contract. The itemized bids will probably be published next week. Constr. Engr., A. J. Gavett, Plainfield.

ALTOONA, PA.—Harvey Linton, Cy. Engr., writes us that the citizens voted March 22 to increase the bonded indebtedness to the amount of $280,000 for liabilities incurred in constructing sewers, and for the construction of a proposed sewage disposal plant, etc.

HARRISBURG, PA.—It is reported that an engineer estimates the cost of a proposed system of 13 miles of pipe sewers at $53,907.

MEADVILLE, PA.—Bids are asked until April 3 for constructing about 7,000 ft. of 10 to 6-in. pipe sewers in three streets. Willis R. Vance, Cy. Clk.

NEW BRIGHTON, PA.—The construction of a system is being considered by the council, according to reports.

PITTSBURG, PA.—E. M. Bigelow, Dir. Pub. Wks., has awarded contracts for constructing sewers to R. Hilias, Sloan & Co., E. Misold, Sawders & Houston and Streets & Hammond, of Ohio.

BALTIMORE, MD.—An ordinance has been passed appropriating $24,000 for extending the sewer in Bruce Alley.

PETERSBURG, VA.—Haskins, Mosby & Co., of Richmond, have been awarded the contract for constructing 4,050 ft. of 18 to 8-in. pipe sewer, according to reports.

TALLAHASSEE, FLA.—The following bids were received for constructing a sewer from the U. S. public building: Justin McCarthy, Washington, D. C., $4,795; time, 75 working days; Owen Patterson, Baltimore, Md., $2,847, 60 days; Stephen S. Leonard, Tallahassee, $1,729, 40 days; John W. Anderson, Tallahassee, $1,723, 35 days; Fish & Hopkins, Tallahassee, $2,600, 59 working days; Gilmore & Davis, Tallahassee, $2,810, 59 days; C. M. Burkhalter & Co., Birmingham, Ala., $1,406, 45 days.

LOUISVILLE, KY.—Bids are asked by the board of public works until April 8 for constructing sewers in nine streets and reconstructing sewers in three streets.

FINDLAY, O.—The council has passed ordinances for constructing 20 to 10-in. pipe sewers in seven streets. S. P. De Wolfe, Cy. Clk.

INDIANAPOLIS, IND.—Bids are asked by the board of public works until April 9 for constructing 956 ft. of 42 to 20-in. brick sewers and 4,506 ft. of 18 to 6-in. pipe sewers in one alley and 730 ft. of 39 to 24-in. brick and 5,240 ft. of 18 to 6-in. pipe sewers in Vermont St.——A resolution has been adopted for constructing 398 ft. of 10-in. pipe sewers in an alley, and plans have been ordered for 2,200 ft. of sewers in two streets, and for about five miles of branches to the 14th St. sewer.

KOKOMO, IND.—The council is considering the question of constructing a 21-in. pipe outlet sewer 4,100 ft. in length, estimated to cost about $6,150.

LAFAYETTE, IND.—Bids are asked until April 8 for constructing 1,570 ft. of 120 and 86-in. brick sewers. W. K. Eldridge, Cy. Engr.

RICHMOND, IND.—Plans are being made for a sewer to drain the territory known as Linden Hill.

ANN ARBOR, MICH.—Geo. F. Key, Cy. Engr., has made surveys for about 78,949 ft. of 15 to 4-in. pipe sewers. We are informed that it will probably be about three weeks before the board of public works will ask for bids for the construction.

LA SALLE, ILL.—The city engineer has prepared plans for sewers in the east end, estimated to cost about $10,000.

WAUKEGAN, ILL.—Bids are asked until April 15 for constructing 2,037 ft. of 18-in. pipe sewers. Henry Thacker, Cy. Clk.

DES MOINES, IA.—The city surveyor has prepared plans for a sewer in several streets.

WYMORE, NEB.—The committee has voted to construct a system.

FORT SHAW, MONT.—Bids are asked for constructing a system at the U. S. Indian Industrial School. W. H. Winslow, Supt.

ST. LOUIS, MO.—The council has passed an ordinance for constructing sewers in sewer district No. 6.

LITTLE ROCK, ARK.—The legislature has passed a bill authorizing an appropriation of $12,500 for a system at the insane asylum.

GRASS VALLEY, CAL.—The city will vote April 2 on a proposition to issue $50,000 in bonds for constructing a system, according to reports.

SUDBURY, ONT.—Bids are asked until May 1 for constructing a system. Engrs., Gordon & Rorke; A. Ferris, Clk.

GARBAGE DISPOSAL.

BOSTON, MASS.—The "Herald" states that the garbage plant in Dorchester will undoubtedly be removed from its present location. The board of health, in a communication to the council, declared it a nuisance, and has also revoked the assignment given to the New England Construction Co. for the experimental plant. The board has placed the matter in the hands of the city solicitor, who has prepared a bill of complaint in the name of the health board to the supreme judicial court, which will be filed at once.

NEW BRIGHTON, N. Y.—It is expected that the question of building a garbage crematory in this place will be settled at once. The matter has been under consideration for a long time, a site has been purchased and proposals have been under consideration. In order that the cost of maintenance might be ascertained, and that no mistake be made in the system to be introduced, it is stated that Engineer Oxholm has recently made visits to various parts of the country where the companies making proposals have crematories in operation. These visits have been unannounced, and the engineer has prepared his report upon the various systems.

NEW YORK, N. Y.—Informal bids for the disposal of 800 tons of garbage daily were received by Col. Geo. E. Waring, Jr., Commissioner of Street Cleaning, on March 25. Up to the time of going to press information regarding the bids was not available, but it is believed that a number of bids were submitted.

ANDERSON, IND.—Harry H. Rogers, Cy. Engr., writes us that the contract for building a garbage crematory has been awarded to Thomas & Perry, of Anderson, at $3,000. Bids were received from several other local bidders, and from the Dixon Sanitary Crematory Co., of Findlay, O., the prices ranging from $3,000 to $3,800.

DETROIT, MICH.—Bids are asked by the city controller until March 30 for the collection and disposal of the garbage of the city for three years.

SAN FRANCISCO, CAL.—The supervisors have been petitioned to advertise for bids for a 50-year franchise for the collection and disposal of garbage in this city. A. E. Williams, G. P. Rixfred and Wakelee & Co. are interested. It is stated that $250,000 would be required to construct a proper plant.

STREETS AND ROADS.

ALBANY, N. Y.—Bids are asked until April 1 for paving Livingston Ave. with dimension granite blocks. Thos. J. Lanahan, Clk. Bd.

BUFFALO, N. Y.—Bids are asked until April 4 for paving two streets with asphalt, stone or brick. R. G. Parsons, Secy. Dep. Pub. Wks.

GLEN COVE, N. Y.—A committee has been appointed to draft a scheme of road improvements and submit it to the people of the town. It is proposed to macadamize the principal highways, at an estimated cost of $10,000 per mile.

HORNELLSVILLE, N. Y.—It is reported probable that considerable paving will be done in this city this summer. Last year $38,425 was spent for paving.

LONG LAKE, N. Y.—At a recent town meeting it was voted to issue $33,000 in bonds to build two roads. David Helms, Supervisor, will negotiate the sale of a portion of the bonds.

PATCHOGUE, N. Y.—Arington H. Carman, Village Clk., writes us as follows in regard to the proposed macadamizing of Ocean Ave. and Main St. in this village: The subject of macadamizing was agitated by some of our more progressive citizens previous to the annual village election, held March 19. The matter was submitted to G. A. Roullier, Cy. Engr., of Flushing, L. I., and the cost was estimated at $40,000; but when we came to get our grade lines we met with some obstacles which required a large expenditure of money for storm sewers, etc., and, owing to the hard times, our people did not favor the movement at the present time. The question of water-works is of more importance at the present time than street improvements, and we hope to be able in the near future to educate our people up to the necessity of these matters, but at the present time it would be folly for us to expect a favorable vote on any question involving a large expenditure of money for any purpose.

POUGHKEEPSIE, N. Y.—E. R. Bogardus, Cy. Chamberlain, writes us that at present petitions are being signed for proposed paving, but it is quite impossible to tell what will be done.

JERSEY CITY, N. J.—Bids are asked until April 8 for 1,250 sq. yds. of paving with Belgian blocks in Westervelt St. Geo. T. Bouton, Clk. St. Comrs.

MERCHANTVILLE, N. J.—At an election April 9 the citizens will vote on an issue of $29,000 in bonds for sidewalk and other improvements.

PITTSBURG, PA.—Bids are asked until March 30 for repaving 36 streets. E. M. Bigelow, Dir. Pub. Wks.

TURTLE CREEK, PA.—The council has voted to issue $20,000 in bonds to pave two streets. C. E. Keister, Clk.

YORK, PA.—J. G. Durbin, Cy. Engr., writes us that the paving and sewer projects have both been defeated and that there is no new work now projected for the coming season.

WASHINGTON, D. C.—Bids are asked by the district commissioners until April 5 for grading and regulating streets, as stated in our advertising columns.

BENWOOD, W. VA.—The council is reported as making arrangements to pave two streets.

ATLANTA, GA.—Bids are asked until April 1 for relaying such sidewalks as may be ordered during the year with cement blocks and granite flagging. D. G. Wylie, Comr. Pub. Wks.

LOUISVILLE, KY.—George Gosnell was the lowest bidder for 12 contracts, and J. R. Nason for the other 6, for which bids were opened last week.

CINCINNATI, O.—Bids are asked until April 18 for paving Vine St. with granite blocks. A. P. Butterfield, Clk. Bd. of Administration.

WARREN, O.—Bids are asked until April 18 for paving two streets, 6,480 sq. yds., with brick; brick to be furnished on the line of the work by the city. A. E. Andrews, Cy. Clk.

INDIANAPOLIS, IND.—The board of public works has adopted resolutions for paving 825 lin. ft. of Pearl St. with brick, and for paving 4,654 lin. ft. in three streets with asphalt.——Plans have been ordered for 6,150 lin. ft. of asphalt paving in two streets, for 5,310 lin. ft. of brick paving in four streets and for 9,590 lin. ft. of cement sidewalks in seven streets.

IRVINGTON, IND.—Bids are asked until April 2 for grading and paving three sidewalks with cement. William C. Smith, Engr.

ADRIAN, MICH.—The council has voted to submit a proposition to the voters at the spring election to issue $50,000 in paving bonds.

ALPENA, MICH.—This county has been authorized to vote on a proposition to issue $100,000 in 40-year bonds for roads. The same question was voted on last year and carried by 500 votes, but the Supreme Court declared the law illegal.

LA GRANGE, ILL.—Bids are asked until April 1 for 4,734 sq. yds. of brick paving, 2,850 lin. ft. of stone curbing and 3,470 cu. yds. excavation in Catherine Ave. Chas. W. Northrup, Village Clk.

URBANA, ILL.—It is stated that considerable paving will be done in this city this summer.

DAVENPORT, IA.—The council has passed resolutions for the paving of several additional streets. N. C. Martin, Cy. Clk.

DES MOINES, IA.—Bids are asked by the board of public works until April 3 for about 16,948 cu. yds. of grading in North St.

ST. PAUL, MINN.—Bids are asked until April 2 for making such paving repairs as may be required during 1895. T. A. Prendergast, Cy. Clk.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until April 9 for macadamizing a large number of streets.

GALVESTON, TEX.—No bids were received by the board of public works March 14 for paving certain streets, and the work will be readvertised. It is stated that the contractors objected to some of the requirements of the specifications.

DENVER, COLO.—The Currant Creek Toll Road Co. has been incorporated, with a capital stock of $5,000, to build a toll road in Park and Fremont counties; directors, J. S. Green, J. J. Burns, J. E. Rizer and W. H. Murray.

SEATTLE, WASH.—The contract for paving Pike St. has been awarded to James Spurr & Co., the bids being as follows: James Spurr & Co., $22,592; Moore, Peters & Co., $28,328; Great Western Lumber Supply Co., $24,471; Sterratt & Goetz, $23,675; J. F. Garrety & Co., $25,529; J. W. Fitts & H. J. Miller, $26,834; Edward Davis, $23,198; Alonzo Hull & C. J. Erickson, $22,930; Flynn & Rockmark, $24,208.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

STONE CRUSHER.—Richmond, Ind.—The council is considering the purchase of a stone crusher.

FILLING, ETC.—San Francisco, Cal.—Bids are asked until April 15 for filling and grading at the Presidio. A. S. Kimball, Ch. Q. M.

DREDGING.—Cleveland, O.—Bids are asked until April 17 for city dredging for five years. J. H. Farley, Dir. Pub. Wks.

COAL CARS.—Pittsburg, Pa.—It is stated that the Oliver Steel Co. will soon be in the market for several hundred more coal cars.

DIKES.—Canning, N. S.—Bids are asked until March 30 for the construction of dikes. Engr., W. R. Butler, Windsor, N. S.; F. W. Borden.

DREDGING.—Newark, N. J.—Bids are asked until April 4 for dredging the Petty St. Canal, about 20,000 cu. yds. J. C. Mundy, Gen. Supt. of Wks.

STREET SWEEPING MACHINE.—Easton, Pa.—Bids are asked until April 11 for one street sweeping machine; pick-up sweeper preferred. H. R. Fehr, Cy. Engr.

land in Cumru, about a mile from the Lebanon Valley Railway bridge, and will erect buildings and three or four large kilns, with a capacity of 60,000 to 70,000 brick a day. It is expected that the plant will be in operation by July.

CONTRACT PRICES.

DREDGING.—Buffalo, N. Y.—We are informed that the following bids were received for dredging Buffalo River, Buffalo Harbor, Peck's Slip and the Blackwell Canal: Hingston & Woods, Buffalo, 11 cts. per cu. yd.; Buffalo Dredging Co., 9⅞ cts.

CAST IRON PIPE.—Cambridge, Mass.—L. M. Hastings, Cy. Engr., writes us that bids were opened March 18 for 112 tons of 40 to 6-in. cast iron pipe, 40 tons of special castings and 12 tons of stock fittings, and the contract for 40-in. pipe awarded to R. D. Wood & Co., at $1,856, being $32 and $22.40 per ton of 2,240 lbs., according to items (a) and (b) of the specifications, and the contract for smaller pipe and specials awarded to Davis & Farnum, of Waltham, at $4,791.

PIPE, VALVES AND HYDRANTS.—Evanston, O.—Chas. A. Ewing, Engr., 36 Carlisle Bldg., Cincinnati, writes us that the contract for materials for the proposed water-works at this place has been awarded to the Addyston Pipe & Steel Co., at $4,194, itemized as follows: 6-in. pipe, 175 tons, at $21.97; 4-in., 1 ton, $21.97; specials, 2 tons, $45; Bourbon Copper & Brass Works' 6-in. valves, 8, at $9; 6-in. valve boxes, 8, $2.15; 4-in. valves, 6, $5.50; 4-in. valve boxes, 6, $2.15; 2½-ft. double hydrant, 6, $17. Andrews & Shields, Hamilton, O., bid $22 for pipe, $50 for specials, and the same bid as the preceding for valves and hydrants. Anniston Pipe & Foundry Co., Anniston, Ala., $22.30 for pipe, $50 for specials, and the same bid as preceding for valves and hydrants; and Geo. B. Hawley, Cincinnati, bid $21.97 for pipe, $45 for specials, and the following for Ludlow valves and hydrants: 6-in. valves, $12; 6-in. boxes, $3.20; 4-in. valves, $6.85; 4-in. boxes, $3.35; hydrants, $22.95.

CORPORATION COCKS AND PLUGS.—Buffalo, N. Y.—We are informed that the board of public works will recommend that the contract for furnishing brass corporation cocks and plugs for the water department during 1895 be awarded to John Reckenwalt, Buffalo, at the following prices: ½-in. cocks, 37 cts. each; ⅝-in., 50 cts.; ¾-in., 70 cts.; 1-in., 90 cts.; ½-in. plugs, 7 cts.; ⅝-in., 10 cts.; ¾-in., 10 cts.; 1-in., 18 cts.

SUBWAY.—Boston, Mass.—B. Leighton Beal, Secy., writes us that the following bids were received by the Boston Transit Commission March 20 for the construction of section 1 of the proposed subway:

VALVES.—Buffalo, N. Y.—We are informed that the board of public works will recommend that the contract for a supply of valves be awarded to the Ludlow Valve Mfg. Co., at $16,675, itemized as follows: 3-in., 0, $5; 4-in., 50, $5.85; 6-in., 250, $9.75; 8-in., 0, $15.90; 10-in., 2, $22.70; 12-in., 2, $28.65; 16-in., 18, $48.80; 20-in., 2, $87.10; 24-in., 1, $146; 30-in., 1, $280; 36-in., 16, $378; 48-in., 10, $953. The Eddy Valve Co. bid $16,780, the Rensselaer Mfg. Co., $16,944, and two local firms submitted itemized bids for Kennedy valves.

BOILERS.—Troy, N. Y.—Geo. B. Fales, Clk. Water Comrs., writes us that the contract for two horizontal return tubular steel boilers of 175 HP. has been awarded to the Franklin Iron Works, at $5,175. Pinkerton & Mull bid $4,850, but this firm had the contract for previous boilers, and the commissioners were dissatisfied with the work.

ASPHALT AND STONE PAVING.—St. Paul, Minn.—Geo. L. Wilson, Asst. Cy. Engr., writes us that the following bids were received for paving Sixth St.: Warren-Scharf Asphalt Paving Co., 17,121 sq. yds. Trinidad Lake asphalt on concrete, at $2.38; 1,500 sq. yds. granite blocks on concrete, $2.50; Hennessy & Cox, Bermudez asphalt, $2.30; granite, $2.50. Local papers state that these bids are the lowest ever received in the city for similar work, and that the contract has been awarded to Hennessy & Cox.

STREET SPRINKLING.—Indianapolis, Ind.—The "News" states that the following bids have been received for sprinkling the streets of the city from April 1 to Nov. 1, 1895, the price given being per 10,000 sq. ft.; at a later meeting of the board of public works nearly all of the bids were rejected, a collusion of the bidders being suspected.

District No. 1—Robert Thomas & Co., $26.45; Fred H. Harting, $26.70; Fuehring Bros., $34.99; Isaac F. Reeder, $27.90; City Sprinkling Co., $33.90. The contract in 1892 was let at $47; 1893, $38; 1894, $29.

District No. 2—Fuehring Bros., $35.50; City Sprinkling Co., $36.70. The contract in 1892 was let at $44; 1893, $35; 1894, $29.

District No. 3—Fuehring Bros., $34; City Sprinkling Co., $35.40. The contract in 1892 was let at $38; 1893, $34; 1894, $27.39.

District No. 4—Fuehring Bros., $36.50; City Sprinkling Co., $39. The contract in 1892 was let at $44; 1893, $39; 1894, $29.

District No. 6—Robert Thomas & Co., $28.45; City Sprinkling Co., $36.70; Henry T. Nolting, $37.47. The contract in 1892 was let at $48; 1893, $42.50; 1894, $27.45.

District No. 7—Robert Thomas & Co., $26.25; Henry T. Nolting, $36.47; City Sprinkling Co., $35.70; Isaac

Bids Received by the Boston, Mass., Transit Commission, March 20, 1895, for Constructing Section 1 of the Subway.

Bidder.	Excav. for incline, 6,870 cu. yds.	Excav., outside trench, 1,150 cu. yds.	Ex. and refill., 2-trk. subw'y, 700 lin. ft.	Ex. and refill., 4-trk. subw'y, 470 lin. ft.	Excav. below subway grade, 200 cu. yds.	Surplus earth removed, 38,000 cu. yds.	Remov'g surplus earth, ½-mile haul.*	Remov'g surplus earth, add'l ¼ mile.*	Surplus earth, 1 mile av. haul, 5,000 cu. yds.	Iron and steel work, roof & sewer g., 1,025 tons.	Brick masonry, Am. cement, 100 cu. yds.	Brick masonry, Port. cement, 810 cu. yds.	Concrete mas., Am. cement, 340 cu. yds.	Concrete mas., Port. cement, 8,500 cu. yds.	Squared stone mas., Am. cem. 100 cu. yds.	Squared stone mas., Port'd cement, 200 cu. yds.	Stone masonry, inclin. sdwks., 1,025 cu. yds.	Coping, stone mas., in-line, 110 cu. yds.	Granite footing stones, 215 cu. yds.	Spruce lumber, in foundat'ns, 25 M. ft. B.M.	Spruce piles in place, 40,000 lin. ft.	Waterproof coating, 9,700 sq. yds.	Total.
Woodbury & Leighton, Boston	$0.90	$0.75	$15.00	$60.00	$2.00	$0.35	$0.35	$0.10	$0.55	$6.00	$11.00	$12.00	$9.50	$11.00	$25.00	$26.00	$25.00	$30.00	$30.00	$22.00	$0.15	$0.50	$231,625
Everson & Liddle, Providence	1.00	1.50	50.00	80.00	2.00	.10	.10	.05	.20	20.00	12.00	15.00	6.50	8.50	11.00	13.00	10.25	36.00	32.00	25.00	.18	.25	230,765
H. P. Nawn, Boston	.70	.70	32.00	40.00	2.00	.37	.21	.10	.41	15.00	13.60	16.50	7.00	8.60	15.40	16.00	15.60	27.60	39.00	35.00	.15	.40	212,602
McCarthy Bros. & Co., Franklin	.50	.60	22.50	40.00	1.00	.25	.28	.14	.56	12.00	12.00	13.00	7.00	8.00	15.00	16.00	18.00	35.00	38.00	28.00	.18	.25	191,910
Washburn & Washburn, Westchester	.75	1.50	35.00	45.00	2.00	.10	.20	.10	.40	5.00	15.00	16.00	6.00	8.00	9.00	11.00	15.00	20.00	30.00	30.00	.20	.50	189,787
F. C. O'Reilly & Co., New York	1.30	1.30	19.70	27.27	1.00	.125	.20	.05	.30	7.00	10.00	12.00	6.50	7.75	13.00	15.00	22.50	40.00	40.00	26.00	.15	.60	183,058
Weaving, Booth & Co., Boston	.965	1.00	32.94	28.17	1.50	.21	.20	.05	.30	8.00	12.65	13.80	5.75	7.60	12.00	13.00	16.67	31.90	25.87	40.00	.0975	.58	182,136
J. W. Hoffman & Co., Philadelphia	.50	.60	20.00	27.00	1.00	.25	.30	.08	.46	12.00	15.30	16.30	5.40	7.70	15.00	16.00	18.40	30.00	30.00	20.00	.12	.50	181,206
Cranford & Co., Brooklyn, N. Y.	.25	.60	15.50	23.25	1.00	.20	.25	.10	.45	8.00	15.00	16.75	5.50	7.75	16.00	17.00	17.60	35.00	27.25	30.00	.30	.25	173,773
R. A. Malone, Boston	.35	.50	11.50	16.50	.60	.20	.30	.20	.70	9.00	11.00	12.50	5.00	6.50	10.00	11.00	15.00	25.00	25.00	20.00	.14	.60	146,604
Jones & Meehan, Jamaica Plain	.60	.80	12.00	16.00	1.50	.20	.40	.20	.80	2.50	12.00	14.00	5.00	6.50	12.50	13.00	14.00	22.00	25.00	26.00	.15	.15	139,602
John McNamee, Brooklyn, N. Y.	.30	.40	11.25	14.38	.80	.20	.20	.11	.42	4.00	10.00	11.00	5.25	6.50	16.00	16.50	16.80	31.50	23.30	32.00	.15	.12	138,484

* These items have been found superfluous, and omitting these, the total bid of John McNamee becomes $137,384, and that of Jones & Meehan, $136,602; contract has been awarded to Jones & Meehan.

HARBOR IMPROVEMENTS.—Providence, R. I.—The council has passed resolutions appropriating $30,000 for improving the harbor, and also $30,000 for dredging the harbor.

ENGINE, LATHES, ETC.—Decatur, Ill.—The H. Mueller Mfg. Co. writes us that it is in the market for a 60-HP. engine, a number of lathes, drop forge hammer, etc.

TELEPHONE SYSTEM.—Fredericksburg, Va.—A telephone franchise has been granted to the Woodbridge & Occoquano Co., and it is stated that a system will be put in at once.

NAVAL SUPPLIES.—Washington, D. C.—Bids are asked until April 2 for a supply of broken stone, gravel, cement, etc., for the navy yard at Norfolk, Va. Edwin Stewart, Paymaster Gen., U. S. N.

TUNNEL.—Lawrence, Kan.—Bids will be asked within a few days for the construction of 932 ft. of tunnel for steam mains, etc., at the Lawrence Indian Industrial School. J. A. Sweet, Supt.

CHEMICAL ENGINE.—Toronto, Ont.—Bids are asked until April 1 for furnishing one one-horse single-tank 80-gallon chemical engine of the latest improved pattern. George McMurrich, Chn. Com.

SITE FOR MANUFACTURING PLANT.—Kilbourn City, Wis.—J. G. Wilmot and A. D. Bowman have completed a dam at this place, creating 7,000 to 8,000 HP. under 10 ft. head, and are taking steps to induce manufacturers to locate here.

STEEL LIBERTY POLE.—Buffalo, N. Y.—We are informed that the board of public works will recommend that the construction of a steel liberty pole be awarded to Riter Bros. at $2,225 for a pole according to specifications, or $2,245 with butt joints and rivets countersunk.

GRADE CROSSING WORK.—Buffalo, N. Y.—Bids are asked until April 3 for masonry, paving and other work necessary for constructing piers and approaches to a viaduct over the New York Central tracks at the Michigan St. crossing, etc. S. J. Field, Ch. Engr. Grade Crossing Com., 276 Main St.

BOILER WORK, ETC.—Newark, N. J.—Bids are asked until March 29 for the boiler work, sterilizer and apparatus connected therewith for the proposed sterilizing plant for disinfecting station for the board of health; plans and specifications prepared by the Hewes & Phillips Iron Works. Wm. E. O'Connor, Cy. Clk.

BRICK PLANT.—Reading, Pa.—Rothermel & Mauger, William H. Fox and Levi Quier have leased six acres of

BOILERS.—Cincinnati, O.—Willis P. Tharp, Supt., writes us that the following bids were received March 13 for six tubular boilers, 48 ins. diameter, 24 ft. long, with 30 4-in. tubes in each, and for six 54 ins. in diameter, 20 ft. long, with 40 4-in. tubes in each; the boilers to be set in batteries of two boilers each at the Hunt St. pumping station:

	48 × 24 ins.	54 × 20 ins.
Variety Iron Works, Cleveland	$1,195	$1,320
W. B. Pollock & Co., Youngstown	1,260	1,320
Miami Valley Boiler Co., Dayton	940	990
Sharon Boiler Works, Sharon, Pa.	890	995
Tudor Boiler Mfg. Co., Cincinnati	999	999
J. K. Rugg, Cincinnati	1,345	1,375
The Brownell & Co., Dayton	1,077	1,186
Robt. Jones & Co., Cincinnati	865	875
McIlvain & Spiegel Boiler Co., Cincin.	820	830
Chas. Barnes & Co., Cincinnati	1,217	1,267
Riter & Conley, Pittsburg, Pa.	1,455	1,535

HYDRANTS.—Buffalo, N. Y.—The following bids have been received for furnishing hydrants during the ensuing year:

	Howard Iron Wks.	Buffalo Forge Co.
6-ft. hydrants, each	$34	$34
5 " " "	33	32
4 " " "	32	32
3 " " "	28	..
1½-ft. " " "	18	..
5-ft. double supply	36	36
6 " " "	36	36
Engel frostproof, with iron work'g cyls.	35	..
" " " brass " "	42	..
Double-sup. hyd's, with 2 6-in. connec's.	36	36

WATER-WORKS.—Knoxville, Ill.—The following contracts have been awarded for furnishing materials for the proposed water-works, as advertised in Engineering News; Engr., Chas. F. Sturtevant, St. Louis: Rumsey & Sikemeier Co., St. Louis, Mo., hydrants, at $20.40 and $20.67 each; all valves and boxes, $389.43; Frost Mfg. Co., Galesburg, Ill., steel stand-pipe, 50 × 11 ft., $1,250; F. B. Hawkins & Co., New York, hemp, 4½ cts. per lb.; R. D. McCracken, Knoxville, Ill., hard-burned brick, common, $5.25 per M.; face, $5.75. The bids for cast iron pipe and specials were as follows: Anniston Pipe & Foundry Co., pipe, $19 per ton; specials, 2 cts. per lb.; Addyston Pipe & Steel Co., $20.25 and 2¼ cts.; Ripley-Detrick Supply Co., $20 and 2½ cts.; Shickle, Harrison & Howard, $19.90 and 2⅝ cts.

F. Reeder, $27. The contract in 1892 was let at $47.50; 1893, $34.50; 1894, $26.45.

District 8—City Sprinkling Co., $35.40; Henry T. Nolting, $34.38. The contract in 1892 was let at $49.25; 1893, $32.40; 1894, $27.99.

District 9—Fuehring Bros., $37.50; City Sprinkling Co., $39.00. The contract in 1892 was let at $46.75; 1893, at $38.40; 1894, at $28.99.

District 10—Henry T. Nolting, $36.44; City Sprinkling Co., $37.00. The contract in 1892 was let at $47.00; 1893, $41.50; 1894, $37.00.

District 11—Henry T. Nolting, $36.47; City Sprinkling Co., $37.00. The contract in 1892 was let at $45.00; 1893, at $37.75; 1894, at $33.00.

District 14—City Sprinkling Co., $36.90; Fuehring Bros., $37.00. The contract in 1892 was let at $48.50; 1893, $39.75; 1894, $28.00.

District 15—John South, $25.99; Fred H. Harting, $27.40; City Sprinkling Co., $36.75; Fuehring Bros., $37. The contract in 1892 was let at $44.70; 1893, $35.75; 1894, $28.99.

District 17—City Sprinkling Co., $36.40; Fuehring Bros., $36.99. The contract in 1892 was let at $46.90; 1893, $39; 1894, $28.

District 18—John South, $25.99; J. Harry Roberts, $38.50. The contract in 1892 was let at $44.75; 1893, $38.65; 1894, $34.50.

District 19—Peter Olsen, $26.80; Fuehring Bros., $34; City Sprinkling Co., $35.40. The contract in 1892 was let at $44; 1893, $38.75; 1894, $27.99.

District 21—Fuehring Bros., $37; City Sprinkling Co., $38.40. The contract in 1892 was let at $39; 1893, $38; 1894, $29.

PAVING.—Chicago, Ill.—The "Times" of March 14 states as follows: City officials declare that street paving this year will cost property owners much more than it did last. The bids opened yesterday were for pavements of nearly every variety laid in the city. On asphalt it is found that the average price is about $2.30 per sq. yd. In 1894 the average was about $1.80. For cedar blocks laid upon hemlock plank the bids last received average about 97 cts. per sq. yd. In 1894 this price was about 79 cts. Cedar blocks laid on macadam was offered yesterday at an average of $1.15. Last year the same work was done for $1. Macadam now averages 99 cts.; last year it was laid for 78 cts. a sq. yd. The bids for brick paving received yesterday are the first since the passage of the new ordinance regulating the quality and size of the manufactured blocks. It is impossible, therefore, to draw comparisons with prices prevailing when the very few

yards of that class of pavement were laid in this city. Bidders on this work, however, notified the commissioner of public works that the price of vitrified brick, such as will come within the city ordinance, has advanced from $2 to $2.50 a thousand since the adoption of a standard by the city. Bids for brick pavement ranged yesterday from $1.78 to $2.24 per sq. yd. One thousand brick will cover about 18 sq. yds. It is stated that brick, which last year could be bought for from $16.50 to $17.50 a thousand, now cost $18 to $18.50.

DREDGING, REMOVING ROCK, ETC.—Newport, R. I.—Capt. W. H. Bixby, U. S. Engr. Office, informs us that the following bids were received March 20 for dredging, breakwater construction and removal of ledge rock:

Dredging in Taunton River, Mass. (per cu. yd.)

	Above 3 Mile Riv.	At 3 Mile Riv.	At the Needles.
Columbus Dred'g Co., Fall River.	$0.81	$1.00	$1.35
Elijah Brainard, New York, N. Y.	0.82	1.04	1.56

Dredging in Providence River, R. I. (per cu. yd.)—R. G. & J. S. Packard, New York, N. Y., 15 cts. if also awarded Green Jacket Shoal; John H. Fenner, Jersey City, N. J., 18 cts. if also awarded Green Jacket Shoal.

Dredging on Green Jacket Shoal, Providence, R. I. (per cu. yd.)—R. G. & J. S. Packard, New York, 15 cts. if also awarded Providence work; John H. Fenner, Jersey City, N. J., 20 cts. if also awarded Providence work.

Dredging in	Hartford D'dg'g Co.	Columbus D'dg'g Co.	Elijah Brainard.
Hyannis Harbor	$0.173	$0.235	$0.25
Edgartown Harbor	0.275	0.225	0.25
New Bedford Harbor	0.17	0.34	0.30
Canapitsit Channel	0.36	.....	....

Dredging in Pawcatuck River, R. I. (per cu. yd.)—John H. Fenner, Jersey City, N. J., $0.295, to begin July 1, 1895; Elijah Brainard, New York, N. Y., $0.45, to begin March 1, 1896.

Stone Work at Nantucket, Mass. (per ton).

Humphrey Toomey, Guilford, Conn.	$1.59
Pigeon Hill Granite Co., Rockport, Mass.	1.71
S. & E. S. Belden, Hartford, Conn.	1.73
Rockport Granite Co., Rockport, Mass.	1.87
Hughes Bros. & Bangs, Syracuse, N. Y.	1.87
W. H. Molthrop & Co., Gales Ferry, Conn.	1.95
Chas. F. Stoll, New London, Conn.	2.85

Removing Ledge Rock in Pawtucket River, R. I.

	per cu. yd.
Rogers & Fitzpatrick, Plattsburg, N. Y.	$7.73
Geo. W. Andrews, Biddeford, Me.	8.13
E. R. Seward, Albany, N. Y.	8.70
Townsend & Johnston, Somers Point, N. J.	9.80
Thos. A. Scott, New London, Conn.	10.90
John H. Fenner, Jersey City, N. J.	12.25

METAL MARKET PRICES.

LEAD.—New York: 3.05 to 3.1 cts. Chicago: 2.95 to 2.97 cts. St. Louis: 2.92 to 2.95 cts.

NAILS.—Pittsburg: 90 cts. for wire, and 80 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.90; plain, $1.20 for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $12.50. Pittsburg: $10 to $11. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1 to 1.1 cts.; spikes, 1.45 to 1.6 cts.; track bolts, 1.75 to 1.85 cts. with square, and 1.9 to 2 cts. with hexagon nuts. Chicago: angle bars, 1.2 to 1.3 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $11.50 to $12 for iron, and $10 to $10.50 for steel; steel rails fit for relaying, $14; light rails, $20 to $22; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over; $23 for light sections; old rails, $12.50 for iron and $10 for steel. Chicago: $23 for standard sections; $25 for light sections; old rails, $10.50 to $11 for iron, and $7.50 to $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.45 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.5 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.5 cts.; channels, 1.2 to 1.5 cts.; angles, 1.05 to 1.15 cts.; tees, 1.2 to 1.25 cts.; universal mill plates, 1.05 to 1.15 cts.; steel plates, 1.1 to 1.2 cts. for tank, 1.2 to 1.25 cts. for shell, 1.25 to 1.3 cts. for flange, 1.75 to 2 cts. for ordinary firebox, and 2 to 4 cts. for locomotive firebox. Chicago: beams, 1.4 to 1.45 cts; channels, 1.4 to 1.45 cts.; angles, 1.2 to 1.3 cts.; tees, 1.6 to 1.7 cts.; universal plates, 1.2 to 1.3 cts.; steel plates, 1.3 to 1.35 cts. for tank, 1.5 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

INDUSTRIAL NOTES.

MOHN & HOFF, Y. M. C. A. Building, Chicago, Ill., have been awarded the contract for the iron work for a warehouse on Van Buren St., Chicago, 40 × 126 ft.; estimated cost, $60,000.

THE MACK MFG. CO., of New Cumberland, W. Va., which operates six large brick yards, with an aggregate capacity of 175,000 brick per day, is changing two of its yards to manufacture sewer pipe.

THE DEAN BROS. STEAM PUMP WORKS, of Indianapolis, Ind., announces that it has removed to its new shops at the corner of First St. and the C., C., C. & St. L. R. R., and now offer its old works for sale.

THE BIRMINGHAM ROLLING MILL CO., of Birmingham, Ala., contemplates undertaking steel manufacture, bringing the molten metal by rail from the blast furnaces of the Sloss Iron & Steel Co. at North Birmingham.

THE LUKENS IRON & STEEL CO., of Coatesville, Pa., has recently received an order for 6,000 tons of open-hearth steel plates to be used in the construction of the cantilever bridge across the East River at Blackwell's Island, New York city.

THE W. H. BLAKE STEAM PUMP CO., of Fitchburg, Mass., has been incorporated to carry on a business which has been in operation for about six years. Pres. and Treas., L. H. Goodnow; Secy., H. C. Deane; Directors, W. H. Blake and Charles J. Buch.

THE HARRISBURG FOUNDRY & MACHINE WORKS, of Harrisburg, Pa., has orders for two 500-HP. engines for the power plant of the Philadelphia, Castle Rock & West Chester Electric Ry., and seven engines for the American Surety and Germania Life Insurance buildings in New York.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., is building a large warehouse in New York city for James Everard; it will be 120 ft. square, 12 stories high, with a steel frame, and will be entirely fireproof. It also has the contract for the new power house of the Metropolitan Electric Co., at Reading, Pa.

THE PENNSYLVANIA VITRIFIED BRICK CO., of Reading, Pa., has been organized to manufacture brick from a yellow shale deposit near Cumru. Building will be erected and a plant established for crushing the slate and pressing the clay into bricks, and there will be three or four kilns, with a capacity of 60,000 to 70,000 bricks per day.

THE CONNELLY GAS ENGINE CO., of New Castle, Pa., manufacturing gas engines and street car motors, states that it has placed one of its gas engines, fitted with a Connelly transmission device, in a combination car furnished by Emerson McMillin & Co., of New York. A trial run has been made with satisfactory results. The present motor will carry a load of 50 or 60 passengers up a grade of 4½ to 5%, and will run 20 miles without recharging the tanks with gas. McMillin & Co. will probably make further trials of the car.

THE RICE & SARGENT ENGINE CO., of Providence, R. I., writes us that during the present month it has received three orders for steam engines. The Pembroke Mills, of Suncook, N. H., ordered a 300-HP. tandem-compound engine, with cylinders 14 × 42 and 26 × 42 ins., independent condenser, and making 100 revolutions per minute. The Lawrence Lumber Co., of Lawrence, Mass., ordered a 200-HP. engine, with cylinders 20 × 42 ins., and making 60 revolutions. The Oakdale Mfg. Co., of Providence, R. I., ordered a 75-HP. engine, with cylinders 12 × 30 ins., making 110 revolutions per minute.

THE H. MUELLER MFG. CO., of Decatur, Ill. (erroneously reported last week as of Decatur, Ala.), informs us that it has sold its factory building in Decatur, and is seeking a new location. The company manufactures water-works and plumbers' supplies, and employs 65 hands at the present time, but expects to increase its force if it can find the right location for its plant. The company expects a liberal bonus to move its factory to any city, and is now ready to correspond with any city in relation to establishing its factory. It is also in the market for a 60-HP. engine, a number of lathes, drop forge hammer, etc.

M. S. DAVIDSON, 77 Liberty St., New York city, informs us that he is building for the Johnson Co., Johnstown, Pa., for use in its mills at Lorain, O., a pair of compound duplex air pumps, which are believed to be the largest ever constructed in this country. They are arranged to run either singly or duplex. The steam cylinders are 16 and 30 ins. diameter; and the air cylinders 36 ins. diameter, with a common length of stroke of 24 ins. There are two of these pumps, and each pair is provided with one jet condenser, 6 ft. diameter and 12 ft. 9 ins. high. The Davidson works have also completed a pair of compound duplex double-plunger pumps for the same concern. Business is reported as very good.

NEW COMPANIES.—Forest City Car & Mfg. Co., Forest City, Pa.; $20,000, with $2,000 paid in; Treas., Henry Box.

Toledo Rolling Mill Co., Toledo, O.; $50,000; A. W. Houston, J. Lawrence Adam and Nelson Sayler.

Ordway Construction Co., Danville, Va.; $100,000; dams, bridges, railways, etc.; Pres., Jas. A. Ordway.

Belvidere Gas Light & Fuel Co., Belvidere, Ill.; $50,000; C. R. Dean, F. S. Rowan and George H. Hurlburt.

Monmouth Sewer Pipe & Tile Co., Monmouth, Ill.; $50,000; J. H. Pattee, William B. Smith and M. C. Soule.

Midvale Paving & Fire Brick Mfg. Co., Midvale, O.; $15,000; James Watkins, John M. Rutledge and J. P. Walters.

Jacob A. Bohem & Brother Co., Philadelphia, Pa., iron manufacture; Treas., 2223 North 15th St., Philadelphia, Pa.

German-American Filter Co., New York, N. Y.; $114,000; J. M. Kauffman, E. L. Foster and W. J. Wanamaker.

Commercial Transit Co., Cleveland, O.; $268,000; navigation, etc.; B. L. Pennington, C. B. Lockwood and M. Taylor.

New York & Missouri River R. R. Co., New York, N. Y.; $1,000; Thomas W. Osborn, Dwight L. Hubbard and John Ford.

Wyandotte Mining, Milling & Smelting Co., Chicago, Ill.; $1,000,000; Theodore Wilkin, William Hattendorf and Peter Lauth.

Claybourne Burner Co., Chicago, Ill.; $1,000,000; oil and gas burners; C. W. Claybourne, Addison Bybe and W. L. Milliken.

Kelsey Electric Railway Specialty Co., New Haven, Conn.; $20,000; Frank N. Kelsey, Charles L. Wright and W. W. Miner.

American Compressed Air Safety Elevator & Novelty Machinery Co., Chicago, Ill.; $200,000; J. S. Trott, E. F. Brooke and S. W. Brooke.

South Chicago & Calumet Lumber Co., South Chicago, Ill.; $80,000; George C. Burrows, Edward C. Donnellson and Wm. C. Rentel.

Woodbine Drainage Co., Harrisburg, Pa.; $15,000, with $1,500 paid in; sewers, culverts and sewage appliances; Treas., John E. Patterson.

Electric Construction & Supply Co., New York, N. Y.; $12,000; Arthur A. Lawrence and Charles F. Parmly, of New York, N. Y.; Frank R. Kinsman, of Plainfield, N. J.

California Improvement Co., New York, N. Y.; $1,500,000, with $500 paid in; railways, etc.; S. H. G. Stewart and E. McMillin, of New York; W. F. Donthest, of Columbus, O.

New Century Motor Co., Camden, N. J.; $50,000, with $1,000 paid in; gas, rotary and other engines; E. R. Johnson, of Camden, N. J.; John F. Fox, and Francis Magee, of Philadelphia, Pa.

ADVERTISEMENTS.

Large sums of money are saved on contracts by advertising work in this paper.

A news item or proposal advertisement in Engineering News is brought to the attention of more contractors and manufacturers of contractors' supplies than if published in any other paper in the world.

PLATE GIRDER BRIDGE, OGDENSBURG, N. Y.

Proposals will be received by the Bridge Commissioners of the town of Oswegatchie unt l 12 o'clock, noon, of April 12th, 1895, for building a Steel Plate Girder Bridge, about 220 feet long, with paved roadway and sidewalks, across the Oswegatchie River at Ogdensburg, N. Y., in accordance with plans and specifications on exhibition at the Journal office, Ogdensburg, N. Y., and at the office of Charles F. Stowell, No. 51 State street, Albany, N. Y.

Proposals will also be received at the same time and place for building a Stone Arch Bridge at the same point; plans and specifications for which may also be seen as above.

A set of plans and specifications for either of the above bridges will be sent to any address on receipt of two dollars upon application to Chas. F. Stowell, No. 51 State street, Albany, N. Y.

The Bridge Commissioners reserve the right to award the contract for either kind of bridge that may seem to it most advantageous, or to reject any or all bids.

All proposals must be enclosed in sealed envelopes and endorsed on the outside "Proposals for Plate Girder (or Stone Arch) Bridge," with the name of the bidder, and addressed to S. H. PALMER,
Chairman Bridge Commissioners,
13-1t Ogdensburg, N. Y.

LYNDONVILLE, VT., WATER-WORKS.

Sealed proposals for furnishing all the labor and materials for building a gravity system of water-works at Lyndonville, Vt., will be received by the Water Commissioners of the Village of Lyndonville, until two o'clock in the afternoon of Wednesday, April 10, 1895, at the office of said Commissioners, when and where the bids will be opened in presence of the bidders. The distribution piping will be of 4-in., 6-in., 8-in. and 10-in. cast iron, aggregating about 3 miles in length. The supply will be taken from one of two sources and bids are required on both. The supply main will be either about 4 miles of 10 in. pipe or about 3 miles of 12-in. pipe. A masonry dam about 12 ft. above brook is to be built at storage reservoir. The work must be finished before Aug. 15, 1895. Contractors are to examine the ground before bidding. Plans and specifications may be seen at Lyndonville. A certified check for five hundred dollars ($500) made payable to the Village of Lyndonville, is to be deposited by each bidder as guarantee of good faith. The right is reserved to reject any or all bids.

O. G. CHASE,
A. D. PAIGE,
GEO. SHOREY,
Board of Water Commissioners.
JOHN W. BURKE,
Engineer.
Lyndonville, Vt., March 20, 1895. 13-1t

PUMPING ENGINES, KNOXVILLE, ILL.

The City Council of Knoxville, Ill., will receive sealed bids for vertical acting pumping machinery and fire pump until 7 o'clock P. M., April 5, A. D. 1895. Each bid must be accompanied by a certified check for one-third the amount. The Council reserves the right to reject any or all bids.

Attest: L. M. SMITH, City Clerk.
J. R. WILDER, Mayor.
CHAS. F. STURTEVANT,
Consulting Engineer,
12-2t 800 North Second Street, St. Louis, Mo.

In the Circuit Court of the United States,

FOR THE DISTRICT OF MARYLAND.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE AIR BRAKE COMPANY. vs. THE BOYDEN POWER BRAKE COMPANY. } In Equity.

(Decided March 11, 1895.)

J. Snowden Bell, Bernard Carter, George H. Christy and *Frederic H. Betts*, for complainants.

Barton & Wilmer, Cowen & Cross, Hector T. Fenton and *Lysander Hill*, for defendant.

This is a bill in equity, in usual form, charging the defendant with infringing the Westinghouse Patent No. 360,070, dated March 29, 1887, for a fluid-pressure automatic brake mechanism.

The Claims of Patent No. 360,070 in Suit.

The claims alleged to have been infringed by the defendant are claims 1, 2 and 4, which are as follows:

"1. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, a triple-valve and an auxiliary-valve device, actuated by the piston of the triple-valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake-cylinder, substantially as set forth.

"2. In a brake mechanism, the combination of a main air pipe, an auxiliary-reservoir, a brake-cylinder and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth.

"4. The combination in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir, and a brake-cylinder and to the atmosphere, respectively, and an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth."

The only defense now urged by the defendant is non-infringement.

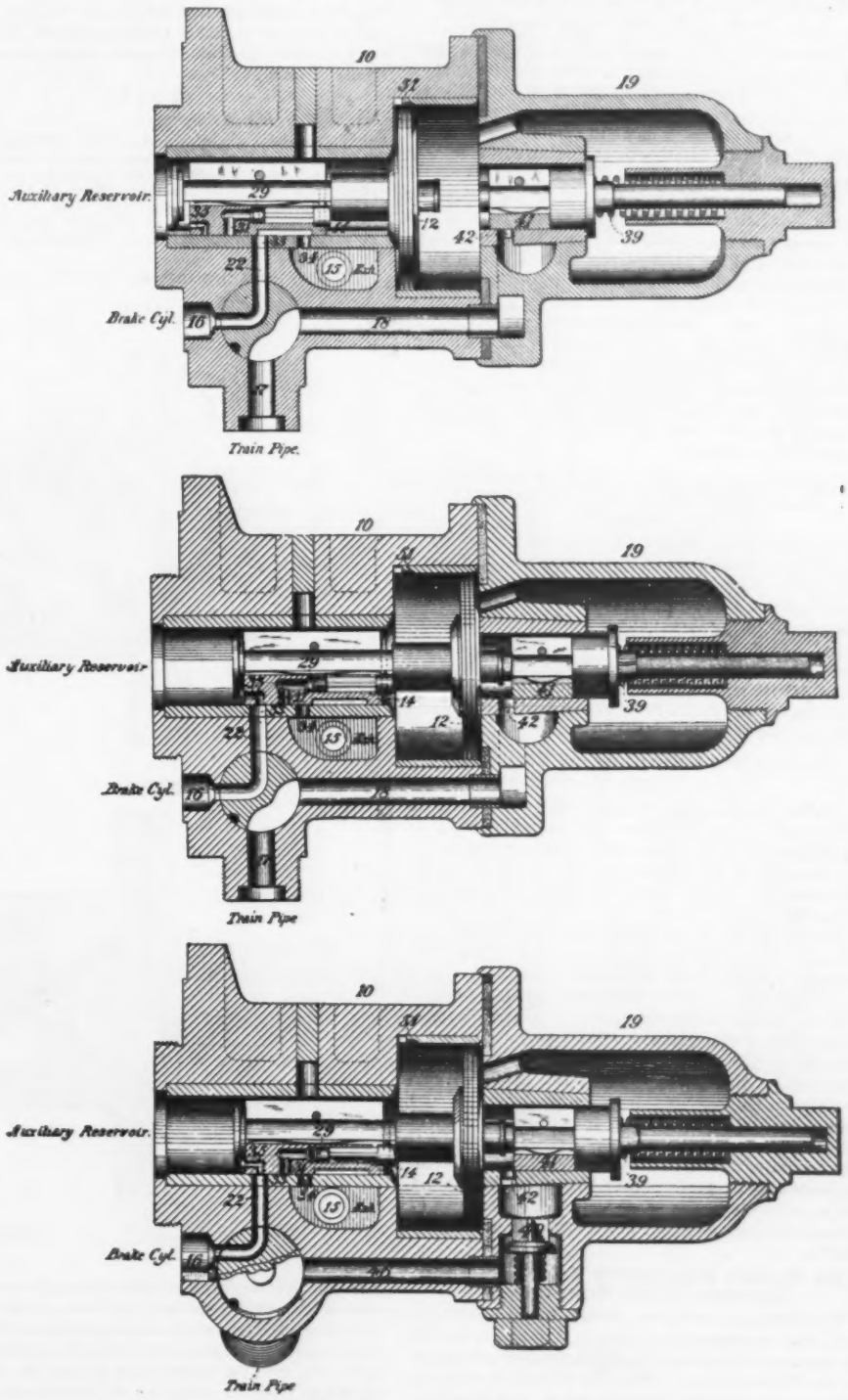
The Development of the Air-Brake.

The history of the pioneer invention of George Westinghouse, Jr., in fluid-pressure brakes, by means of which the brakes of a train of railroad cars can be operated by air pressure controlled by the engineer of the train, and the history of the successive steps and inventions by which he has devised mechanisms adapted to apply that power so as to act automatically on each car, and the scope and fundamental importance of his later inventions by which he has accelerated, in an astonishing degree, the quickness with which the brakes can be applied, almost simultaneously, on each car of a long train consisting of as many as fifty freight cars, has been carefully and fully stated by Judge Townsend, who delivered the opinion in the case of Westinghouse vs. New York Air Brake Co. (59 Fed Rep., 581), and by Judge Shipman in the same case on appeal (63 Fed. Rep., 962), and in the opinion of Judge Lacombe, filed December 27, 1894, in a case between the same parties in the United States Circuit Court for the Southern District of New York.

Objects to Be Attained in a Quick-Action Air-Brake.

The patent now in suit, No. 360,070, March 29, 1887, is the first of the Westinghouse patents in which he describes an additional function, engrafted upon his automatic air-brake, which is intended to be used only in cases of unusual emergency, and which is intended to meet the difficulties of applying air-brakes quickly on long trains. The purpose of the device was to increase the quickness of the serial action of the automatic brake mechanism on each successive car, by making the triple-valve device of each brake mechanism set in operation the valves on the car immediately in its rear, and at the same time to make use of the train-pipe air, vented for this purpose from the train-pipe at each triple-valve, so as to add its power to the power applied from the auxiliary-reservoir of each car.

The result which Westinghouse was seeking in the new device, described in Patent No. 360,070, was first and principally to vent the train-pipe at each car, so as to quicken the serial action of the brakes from car to car; and, secondarily, to utilize the vented air and not waste its power.



WESTINGHOUSE VALVE NO 360,070.

Method by which these Objects were Attained.

Westinghouse discovered that he could accomplish this result by so constructing the ordinary triple-valve of his automatic mechanism that, when in an emergency, the engineer, by widely opening his engineer's valve and thereby causing a sudden and unusual release of pressure in the train-pipe, could cause the piston of the triple-valve to make an unusual and further traverse and thereby actuate a valve, which opened a port by which the train-pipe air was admitted suddenly and directly into the brake-cylinder, without passing through the auxiliary-reservoir.

This sudden release of air from the train-pipe vented that pipe at the first car, and that venting in like manner, released the pressure in the train-pipe at the valve of the next car, and so on from car to car with almost instantaneous rapidity.

Defects in the Proportions of the First Valves Constructed.

It is shown that this device, as first constructed, was not entirely successful. It applied the brakes with greatly increased serial rapidity, as compared with any former device, and with much greater power, but not so quickly but that the rear cars impinged against the forward ones with destructive shocks.

The reason for this appears to have been that the operation of venting was not carried far enough, because the port opened by the auxiliary valve was not of sufficient size and did not release the full

volume of train-pipe air suddenly enough to vent it sufficiently. This defect was remedied by an improved mechanism, devised by Westinghouse and described in his Patent No. 376,837, January 24, 1888.

The Method is Successful and the Invention of Great Importance.

The success of this improved device has demonstrated that the invention, by which the further traverse of the triple-valve piston, beyond the extent of the traverse required for the ordinary application of the brakes, is made to admit a large volume of train-pipe air directly to the brake-cylinder, was one of great importance.

The proofs show that a quick-action automatic brake, which would give the results which this brake has accomplished, was eagerly sought after by inventors and car builders, and all had failed, until Westinghouse discovered that it could be done by this mode of operation.

In the cases above referred to, in which this Patent, No. 360,070, and the improvement on it, No. 376,837, were discussed with reference to the state of the art and the scope of the invention therein disclosed, these were held to be patents of a fundamental pioneer class, describing an invention of primary importance.

The Essence of the Invention is Independent of the Form of the Emergency Valve.

In those cases, the defendants, who were charged with infringing, were using a separate and independent valve to open the port to the train-pipe, and the question was whether or not Westinghouse was restricted to the form of independent valve and the precise mode of actuating it set out in his patent. It was held that he was entitled to a liberal construction of his claims, and that, in respect to the emergency valve, the form of his device was not of the essence of his invention.

Character of the Boyden Emergency Valve.

In the Boyden mechanism, which is alleged in this case to infringe, I have not been able to satisfy myself that Boyden makes use of an auxiliary valve, in the sense in which that term is employed in the specification and in some of the claims of the Patent No. 360,070, now in suit.

It appears from the specification of Patent No. 360,070, that what Westinghouse meant by the auxiliary valve, which is made one of the elements of the combination in the first and fourth claims, is such a valve as he has described in his specification, and which is independent of and performs none of the functions of the main valve of the ordinary triple-valve device, and I am not satisfied, notwithstanding the very positive testimony of the complainants' experts, that the poppet-valve 22 of the Boyden mechanism is such a valve; for Boyden's poppet-valve 22 does, as I understand its operation, to some extent, perform the functions of a main valve of the triple-valve, as well as the functions of Westinghouse's auxiliary quick action or emergency valve.

The Boyden Emergency Valve not Independent of the Main Valve.

It is probably true that, in the Boyden mechanism, the stem valve *i*, *k*, *j*, which I take to be the equivalent of the sensitive graduating valve shown in the Westinghouse Patent No. 220,556, October 14, 1879, is so constructed that it may do, and probably in most cases does do, the work of ordinary braking; that is to say, that, by two or three successive applications of pressure through that smaller and more sensitive valve, the brake-cylinder is filled and the main valve 22 becomes non-essential, or, if lifted off its seat, is moved very gently; but valve 22 will, if the engineer uses his brake valve carefully, do the work of a main valve, as is demonstrated. I think, by the experiments in which the sensitive graduating valve *i*, *k*, *j* was plugged up. So I take it that defendant's valve *i*, *k*, *j*, must be held to be the sensitive graduating valve usual in triple-valve devices since the Westinghouse Patent No. 220,556; and the defendant's valve 22 must be considered to be the main valve, and that in defendant's mechanism he has been able, by an ingenious arrangement, restricting the admission of auxiliary-reservoir air to the triple-valve chamber, to cause the main valve to do both main-valve work, when needed, and to do quick action work, when needed.

Claims 1 and 4 in Suit not Infringed by the Defendant.

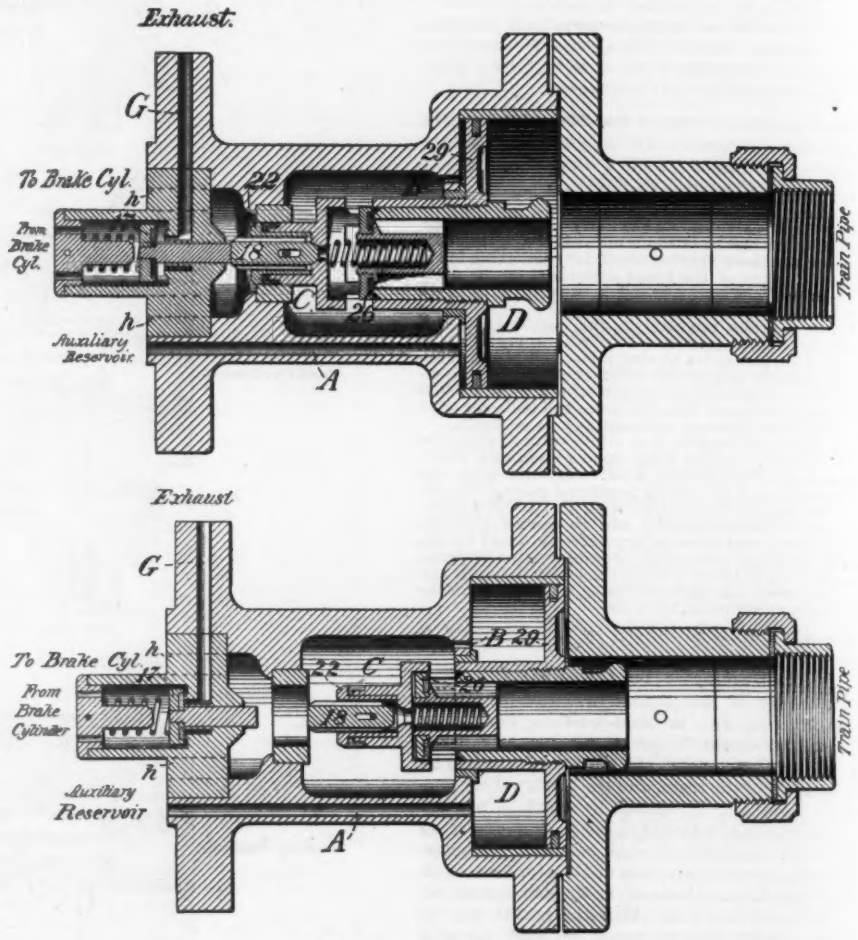
As, by the explicit terms of claims 1 and 4, Westinghouse has restricted himself, as to those claims, to an auxiliary valve, independent of the triple-valve, I hold that the defendant does not infringe those claims.

CLAIM 2.

Claim 2 reads as follows:

"2. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, and a triple-valve having a piston, whose preliminary traverse admits air from the auxiliary-reservoir to the brake-cylinder, and which, by a further traverse, admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth."

The first three elements of this claim are the usual



BOYDEN, 1889 CATALOGUE.

mechanism of an automatic air-brake; the remaining element, which was the only novel one at the date of the patent, is a triple-valve having a piston which, by two distinct movements, performs two distinct functions; the first, its preliminary traverse by which it admits air from the auxiliary-reservoir to the brake-cylinder, which is the ordinary effect of the usual movement of the triple-valve piston, and the second, its further traverse, which is a new and distinct use, admitting air directly from the main air-pipe to the brake-cylinder, resulting in venting the main air-pipe and in producing the quick-action.

The Broad Invention of Patent No. 360,070.

Now this, as I understand it, was the invention which Westinghouse brought to light. He discovered, and by experiment demonstrated, that, by a further traverse of the triple piston, train-pipe air could be vented from the train-pipe and that it would give two very important results, namely: first, quickening of the action of the brakes from the forward to the rear cars so that the application of the brakes became almost instantaneous on all the cars, and second, utilizing the vented air for direct action in the brake cylinder. Now, although quick-action emergency brakes were being sought for, no one before Westinghouse had accomplished this result and the means by which he accomplished it were entirely novel. Indeed, upon first impression, it is paradoxical and startling to find that, when a sudden, quick and powerful application of brakes is needed, in the face of impending danger, it is to be obtained by a sudden large release of the pressure in the train-pipe, to the extent of fifteen or twenty pounds below that in the auxiliary-reservoir, and that, by using this low pressure air to operate the brake-cylinder, instead of the air under greater pressure stored in the auxiliary-reservoir, this remarkably effective application of the brakes is obtained. In the domain of quick-action brakes, this device would seem to belong to that class of pioneer inventions, the patents for which are to be construed so as to be coextensive with the real invention, if the language of the claim will permit it.

Claim 2 of Patent No. 360,070 Covers all Quick-Action Triple-Valves Operating by a Double Traverse of the Piston.

It is shown that Westinghouse was the first who used a further traverse of the triple-valve piston to perform the operation required to vent the train-pipe into the brake-cylinder to effect quick action. The result was new and the means were new. His claim 2 is broad enough in language to cover every device in which that is done by the further traverse admitting air directly from the train-pipe to the brake-cylinder, substantially by the means described in the specification; that is, by the further traverse actuating a valve which so admits the train-pipe air.

The result accomplished by defendant's mechanism is identical with that of Westinghouse, and the means, by which the mechanism is actuated, so alike, that, in its published trade catalogue, defendant claims that cars fitted with its valves can be used on the same trains with the Westinghouse

quick-action brake, because the engineer, in applying or releasing the air-pressure, may treat them as identical; the same functional operations of the valves, and the same results, being obtained from the same changes in the engineer's brake valve, so that there is strong *prima facie* reason to suppose that Boyden's way of using the same release of pressure to vent the train-pipe and to actuate the valves, which produces the identical results, may be Westinghouse's way.

In Compressed-Air Mechanisms, Infringement depends upon Functional Equivalents.

In mechanisms actuated by air under pressure, the transmission of power is not visible to the senses as plainly as when it is done by cranks and levers, and being transmitted by an invisible agency in all directions in which the air can escape, the functions of the instrumentalities by which it operates are more important than their forms, and, in judging of an infringement, we are to direct our minds rather to functional equivalents and mechanical equivalents.

Boyden Merely Adapted Old Devices to Perform the Function Discovered by Westinghouse.

The use by Boyden of a central opening through the triple-valve piston, to admit train pipe air to the triple-valve chamber, was not new, nor the use of a poppet-valve for the main valve of the triple, both of these constructions having been shown in the Westinghouse Patent No. 141,685, August 12, 1873, and in others of his patents. So that there is nothing in the Boyden device not before exhibited in some one of the Westinghouse Patents; except that he has been able to cause one of the valves of the triple (valve 22), at one stage of the application of brakes, to perform ordinary service work, and, at another, to do quick-action work. This Boyden does by an ingenious construction not before used, by which he restricts the passage of auxiliary-reservoir air into the triple-valve chamber, so that, when the further traverse of the piston suddenly unseats the poppet-valve 22, the port opened by it to the brake-cylinder is so large and the supply of auxiliary-reservoir air through the restricted passage so feeble, that the train-pipe air raises its check-valve and vents itself into that chamber, and thence through the large port to the brake-cylinder. For the mechanism embodying this ingenious contrivance, by which the poppet-valve 22 is made capable of doing ordinary service work by a careful, intermittent, slow release of pressure by the engineer, and quick-action work by a quick, sudden release, patents were granted to Boyden (No. 481,135, August 16, 1892, and No. 481,136, August 16, 1892), but, if this construction contains the underlying invention of the patent in suit, which was granted March 29, 1887, Boyden cannot make use of his improvement during the life of that patent.

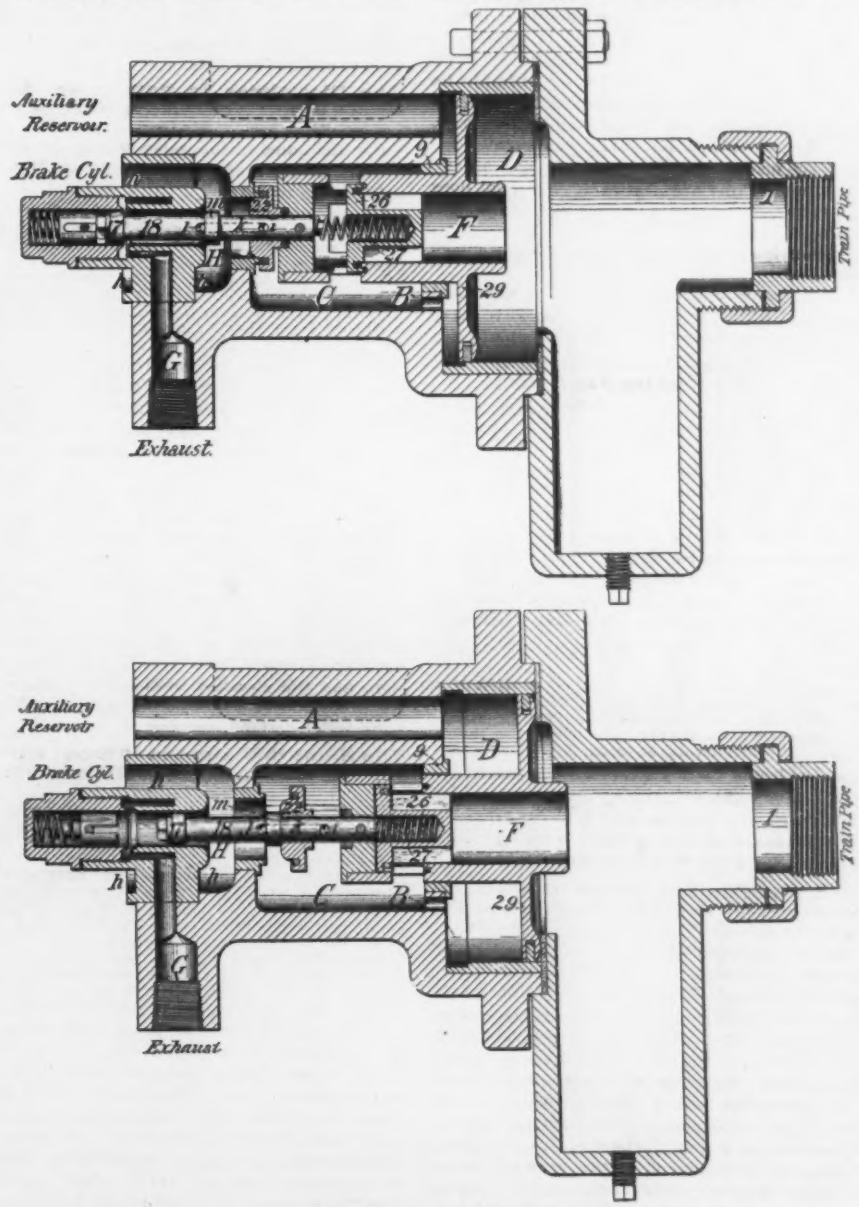
Earlier Devices for Venting the Train-Pipe Do Not Anticipate the Westinghouse Quick-Action Invention.

It is true that, in searching for some device which would give quick action, Westinghouse had, before the date of the patent in suit, conceived the idea that it might be accomplished by venting the train-pipe at intervals along the train. He had tried having two or three vents, at intervals in the length of the train, controlled by electrical apparatus, and also had tried relief-valves placed in the pipe-coupling of each car, which would open to the atmosphere and vent the train-pipe quickly in case of accident or other sudden release of pressure in the forward part of the train. This was shown in the Westinghouse Patent No. 217,838, July 22, 1879, but neither of these attempts were successfully applied, and they did not solve the problem of quick-action.

The problem was not solved; indeed, the first step in the direction of solving it does not appear to have been taken until the experiments which led to the Westinghouse Patent now in suit. The substance of the method then devised is the use of the sudden further traverse of the triple-valve piston to open a valve in a manner different from the valve opening made by the preliminary traverse for service braking, thereby admitting train-pipe air to the brake-cylinder, without its passing through the auxiliary reservoir.

The Boyden Device is Functionally the Equivalent of the Westinghouse.

In the Westinghouse apparatus, the further traverse of the triple-valve piston causes it to impinge against an additional, separate valve which admits the train-pipe air. In Boyden's apparatus, used by defendant, the further traverse pulls the poppet-valve 22, which Boyden substituted for the ordinary main valve of the triple, suddenly off its seat, thereby, in the manner before mentioned, causing the train-pipe air to raise the check-valve and flow with volume, through the triple-valve chamber, direct to the brake-cylinder. The device in Boyden's apparatus, by which the difference of pressures in the triple-valve chamber, between auxiliary-reservoir air and the train-pipe air, is produced and used, is ingenious and admirable; but the result obtained is just the same as when, in the Westinghouse apparatus, the auxiliary valve is unseated, and the means used are, in my judgment, functionally equivalent.



BOYDEN, 1891 CATALOGUE.

Under the ruling of Morley Machine Co. vs. Lancaster, 129 U. S., 263, and of the many cases cited in the opinion delivered in that case, the rights of a pioneer inventor are infringed by one who accomplishes the same result by means which, although never used for that purpose before, are mechanical equivalents for the means used by the inventor, under a liberal construction of his patent. It was said in that case by Mr. Justice Blatchford (p. 273):

"Where an invention is one of a primary character and the mechanical functions performed by the machine are, as a whole, entirely new, all subsequent machines which employ substantially the same means to accomplish the same result are infringements, although the subsequent machine may contain improvements in the separate mechanisms which go to make up the machine."

In McCormick vs. Talcott, 20 How., 402, the controversy arose over a device which McCormick had added to his reaper called a divider, intended to separate the standing grain to be left from that which is to be cut. The Court said:

"If he be the original inventor of the device or machine called the divider, he will have the right to treat as infringers all who make dividers operating on the same principle and performing the same functions by analogous means or equivalent combinations, even though the infringing machine be an improvement of the original and patentable as such."

In Machine Co. vs. Murphy, 97 U. S., 120-125, it was said:

"Nor is it safe to give much heed to the fact that the corresponding device in two machines, organized to accomplish the same result, is different in shape or form the one from the other, as it is necessary in every such investigation to look at the mode of operation or the way the device works, and at the result as well as at the means by which the result is attained."

The language of the Supreme Court in Consolidated Valve Co. vs. Crosby Valve Co., 113 U. S., 157-171 is applicable.

"The prior structures never effected the kind of

result attained by Richardson's apparatus, because they lacked the thing which gave success. . . . Taught by Richardson, and by the use of his apparatus, it is not difficult for skilled mechanics to take prior structures and so arrange and use them as to produce more or less of the beneficial results first made known by Richardson."

It is true that a patentee can claim nothing beyond the scope of his patent (Keystone Bridge Co. vs. Phœnix Iron Co., 95 U. S., 274), but the scope and meaning of a broad claim in the patent can only be interpreted by an understanding of the real scope of the invention itself.

If the Westinghouse Patent now in suit is for an invention of a primary character, and if the gist of that invention is the use of the further traverse of the triple-valve piston to open a valve which admits air directly from the train-pipe to the brake-cylinder, with the result that the train-pipe is vented and the train pipe air utilized, then it appears to me that the defendant cannot exculpate itsef from the charge of infringement by the fact that, in its device, the train-pipe air is admitted through the triple-valve chamber and not through a by-passage, nor by the fact that in its device the further traverse of the piston opens the main valve in a special manner, which produces the same result, but does not make use of a separate auxiliary valve; provided, Westinghouse has not by the explicit terms of his claim 2 restricted himself to the use of an auxiliary valve.

I do not think Westinghouse has so restricted himself in claim 2, although he does appear to have done so in claims 1 and 4.

The Patent Office Amendments Do Not Narrow the Scope of the Patent.

There is, without question, some difficulty and embarrassment in the broad construction of claim 2, growing out of the proceedings in the Patent Office, as shown by the file wrapper and contents; but, considering what was the real invention, I am not of the opinion that the legal effect of those proceedings is to restrict claim 2 to a device containing a separate auxiliary valve.

From the contents of the file wrapper, it appears that, as the application was prepared, the first claim of Patent No. 360,070 differed from that which now appears in the patent as granted.

The claim 1 first proposed was:

"1. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake cylinder, a triple valve provided with a device for admitting air directly from the main air-pipe to the brake-cylinder, substantially as set forth."

It was objected by the Patent Office Examiner that this claim and also claim 2 were anticipated by Patent No. 280,285, to G. A. Boyden, June 26, 1883, and the Examiner requested that a working model of the triple valve should be furnished.

Boyden's Earlier Patent Did Not Anticipate the Quick-Action Triple-Valve Invention.

Boyden's Patent of 1883, No. 280,285, was a form of triple valve mechanism, intended for use with Westinghouse's automatic air-brake, the object of which was to provide for replenishing the auxiliary-reservoir of each car when the pressure therein had been lessened by leakage and while the brakes remained applied. This was done by the engineer causing, not a release, but a slight increase of the pressure in the train-pipe air, which, acting upon a check-valve in the center of the triple-valve piston, by a peculiar arrangement of the valves, caused train-pipe air to pass together with auxiliary reservoir air to the brake-cylinder. The object, function and result of whatever was new and patentable in this Boyden device was altogether different from the object, function and result of the Westinghouse device in Patent No. 360,070, and there seems to be no analogy or comparison which can be made between them.

It is true that the "always-open one-way passage" in the Boyden Patent which, when the check-valve was raised, allowed train-pipe air to reach the brake-cylinder, was, in the language of the cancelled claim 1 of No. 360,070, "a device for admitting air directly from the main air-pipe to the brake cylinder," and there were other devices, used by Westinghouse himself, which this wording would include; and the claim was, therefore, justly open to the criticism of the Patent Examiner; but there was no similarity in the means by which the two devices were actuated, no similarity in the object to be accomplished, and no similarity in the mechanical principle of operation. It was simply a fact that there did exist in the Boyden device a passage for train-pipe air direct to the brake-cylinder, which the engineer could cause to open by a slight increase of train-pipe pressure; but there was no hint or suggestion of the important discovery how that fact could be utilized to accomplish the entirely new function necessary to create a quick-action brake, when, in an emergency, quick-action was needed; and how, when quick-action was not needed, it should not interfere with ordinary graduation and service stops. This Boyden device was not in the direction of quick action, but its opposite.

While, therefore, it was proper that Westinghouse's original claim 1 should be corrected, so as to express more definitely his real invention, this was not because the Boyden Patent, in any manner whatever, anticipated that invention, or suggested it in any of its functions.

The Disclaimer in Patent No. 360,070 Does Not Weaken the Force of the Claims.

For the same reason, there was then inserted in the specification of the Westinghouse Patent No. 360,070, this clause:

"I am aware that a construction, in which 'an always-open-one-way passage' from the main air-pipe to the brake-cylinder is uncovered by the piston of the triple-valve, simultaneously with the opening of the passage from the auxiliary-reservoir to the brake-cylinder, has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I, therefore, hereby disclaim."

In the Boyden infringing device now used by the defendant, the passage from the main air-pipe to the brake-cylinder is not "uncovered by the piston of the triple-valve, simultaneously with the opening of the passage from the auxiliary-reservoir to the brake-cylinder"; if it was, the defendant's mechanism would be always a quick-action brake and never anything else; but, on the contrary, in the infringing device, the passage is not opened until there has been a sudden further traverse of the piston, which then brings it into operation for the distinct purpose of quick-action. The statement of the so-called disclaimer is strictly true, that the construction of the Boyden 1883 Patent "involves an operation different from" the Westinghouse invention, and the so called disclaimer in reality disclaims nothing which has relation to the Westinghouse quick-action invention.

The Right to Claim the Integral Valve Arrangement in 360,070 was not Forfeited.

The disclaimer was substituted in the place of the following, which had been in the specification, and was cancelled:

"Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve separate from that which effects the preliminary admission of reservoir-pressure to the cylinder, a modification, in which the same office is performed by a valve integral with the main valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention."

The testimony tends to prove that this clause of the specification was taken out because the Examiner objected that no such form of triple-valve was illustrated in the drawings. For whatever reason it may have been cancelled, it is not a necessary result that the patentee is precluded from claiming that his patent covers other forms of valve, integral with the main valve, if such is his legal right, when his invention, as disclosed in his patent, is found to be a broad one, and if he is not restricted by his claims and if he has done nothing to impair his right to be protected in his whole invention. The effort should be to preserve, rather than to forfeit, the inventor's rights.

Keystone Manufacturing Co. vs. Adams, 151 U. S., 144.

The object and scope of the invention, and the means employed to effect his object, are thus stated by Westinghouse in the specification of his patent in suit:

"The object of my invention is to enable the application of brake-shoes to car wheels, by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length; as well as to economize compressed air in the operation of braking by utilizing in the brake-cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere. To this end, my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary-reservoir, a brake cylinder and a triple valve device governing, primarily, communication between the auxiliary-reservoir and the brake cylinder, and, secondarily, communication directly from the brake pipe to the brake cylinder."

This language exactly describes the infringing mechanism of the defendant.

The amendments made to meet the objections of the Patent Examiner are not to be construed to disclaim the patentee's actual invention, if such construction can be avoided without doing violence to the obvious meaning of the language.

Lake Shore Railway Co. vs. Car Brake Co., 110 U. S., 229-236.

Reese Button Hole Machine Co. vs. Globe Button Hole Co., 61 Fed. Rep., 958.

The Validity of the Patent is not Impaired Through the Defective Character of the First Valves Manufactured.

It has been urged that the invention disclosed by the patent in suit is not of a meritorious character, because, in the form in which it is there embodied, or at least in the first mechanism manufactured by Westinghouse, it failed of success in some essentials, and was immediately improved by Westinghouse, in a manner which was the subject of a subsequent patent, before it was successful in the use for which it was intended. The defect developed by experimental test, and which Westinghouse in a few months remedied, was that the opening uncovered by the auxiliary valve was not sufficiently large to suddenly release the full volume of train-pipe air. This was not a defect inherent in the device (59 Fed. Rep. 581-591).

There were structural objections to making that opening large; but, when made larger, the device answered the purpose for which it was intended. It was thought, however, better to remedy the difficulty by adding an auxiliary piston, as well as an auxiliary valve, and it was in that line that Westinghouse carried his further improvements, and he has adopted that form as the best to be manufactured for general use.

This defect in the patent in suit was not radical, and was only one of those defects common in the first forms of many pioneer inventions, which usually have to be improved upon before they can attain commercial success.

It is further urged that in a doubtful case the scale should be turned by the fact that, subsequent to the date of the patent in suit, indeed more than two years after the institution of this suit, Patents Nos. 481,135 and 481,136, August 16, 1892, were granted to Boyden for the mechanism now used by the defendant.

Boyden was entitled to patents for whatever was a patentable novelty in the devices by which he was able to make his valve 22 answer for both service and quick-action work, in connection with the restricted passage *B*, and for any other patentable novelty in the forms of his mechanism. The widely different forms in which he has illustrated his devices in the two above-mentioned patents show that, taking what Westinghouse has discovered and demonstrated to be the underlying principle of a quick-action brake a skillfull and inventive mechanic can devise many forms for applying it.

But, in his specification of Patent No. 481,135, Boyden alleges that his device differs essentially from Westinghouse's Patent No. 360,070, and involves a new mode of operation. The question whether it does or not, was the very question pending in this suit, and, so far as the Examiner passed upon it, in allowing the specification to stand, he did so upon the *ex parte* application of Boyden and unassisted by testimony as to the state of the art at the date of the Westinghouse Patent, without testimony as to the scope of the Westinghouse quick-action invention and its great importance and merit; and, therefore, without the opportunity of judging whether or not it was a pioneer invention of a fundamental character, entitled to a construction co-extensive with the invention, or was simply a patent for an improvement in a known art, to be restricted to the form of the device shown in the model and illustrations.

The determination of that question is the starting point in the consideration of the controversy and, in my judgment, the fact that Westinghouse was the first discoverer of the vital underlying invention, should turn the scale in his favor.

An Injunction and an Accounting is Ordered.

The complainants are entitled to a decree for an injunction and account, with a reference to a Master in the usual form.